South Valley Agrichemical Water Quality Impact Study

and

Surface Water Monitoring Results for Acequias Located within Bernalillo County, 2005

Prepared For:

BERNALILLO COUNTY BOARD OF COMMISSIONERS

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Acronyms and Abbreviations

BCPW	Bernalillo County Public Works Division
BCEHD	Bernalillo County Environmental Health Department
BCOEH	Bernalillo County Office of Environmental Health (successor of BCEHD)
CABQ	City of Albuquerque (or the City)
cfu	colony forming unit (a measure of bacteriological concentration)
GPAB	Groundwater Protection Advisory Board
GPPAP	Groundwater Protection Policy and Action Plan
JAD	Joint Administrative Directive
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
mg/L	milligrams per liter
MRGCD	Middle Rio Grande Conservancy District
NMED	New Mexico Environment Department
NWQA	National Water-Quality Assessment Program
OSE	New Mexico Office of the State Engineer
QC	Quality Control
RfD	Reference Dose
SVPEJ	South Valley Project for Environmental Justice
SLD	State Laboratory Division
SVOC(s)	Semivolatile Organic Compound(s)
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Load
UNM	University of New Mexico
U.S. EPA	United States Environmental Protection Agency
USGS	United States Geologic Survey
VOC(s)	Volatile Organic Compound(s)
ug/L	micrograms per liter

Executive Summary

This report documents results of surface water and groundwater monitoring conducted during 2001 to 2005 in the South Valley area of Bernalillo County, NM. The agricultural chemical (agrichemical) water quality impact study is based on samples collected from a monitoring network of a forty-five surface water and shallow groundwater sampling locations located in the South Valley exclusive of acequias samples collected by others. The sampling locations are located in three transects. The transects include surface water sites at the inlets to canals and drains near the Rio Grande in the north part of the South Valley, and surface water and adjacent monitoring well locations in transects along Rio Bravo Blvd. and along Malpais Rd. The sampling locations are within or adjacent to irrigation canals and drains in the South Valley on Middle Rio Grande Conservancy District (MRGCD) property. Water samples were collected during the period of 2001 to 2005 and analyzed for a constituent list useful for detecting and characterizing agricultural chemical water quality impacts.

The samples collected for this study are representative only of the surface water and groundwater affected by surface-water interaction along the irrigation drainages and canals and may not be representative of groundwater conditions in outlying areas. Other areas of groundwater contamination are known to exist within the South Valley area. This study was not designed or intended to address groundwater contamination issues within those known areas. Within the stated limitations, the findings of this report indicate that the irrigation water, drainage water, and immediately adjacent shallow groundwater in the South Valley do not typically contain detectable levels of herbicides or pesticides or other organic compounds or exhibit significantly elevated levels of inorganic contaminants.

To date, the analytical results from surface water samples and samples from the monitoring wells have yielded no detections of any pesticides, herbicides, or other organic compounds indicative of agrichemicals. Any elevated levels of inorganic constituents, such as nitrates, are readily attributable to other sources, and elevated measurements of fecal coliform found in other overlapping studies are attributable to multiple sources present within the study area as well as to livestock operations.

A companion study, *Surface Water Monitoring Results for Acequias Located within Bernalillo County, 2005,* is described in Section 1.3 and Appendix A. The study was conducted as a collaborative project between the Bernalillo County of Environmental Health, New Mexico Environment Department (NMED), Surface Water Quality Bureau, and the South Valley Partners for Environmental Justice. Sampling was done at eight sites selected by community organizers who were knowledgeable with previous illegal dumping near the acequias. Results of the study indicated that *E. Coli* concentrations in three of the eight sites (i.e., the San Jose Drain site, the Los Padillas Drain site, and the Albuquerque Riverside Drain site) exceed New Mexico Administrative Code standards for at least part of the year. The San Jose Drain site also exceeded the standard for dissolved mercury in the fall. There were no exceedances of semivolatile organic compounds water quality standards, although soil samples from the Sand Jose Drain site did exceed the reference dose (RfD) for three semivolatile organic compounds, but did not exceed health based screening standards.

Based on the findings of the *Agrichemical Water-Quality Impact Study* and of *Surface Water Monitoring Results for Acequias Located within Bernalillo County, 2005*, the following recommendations are proffered:

- Discontinue routine water quality monitoring of the surface water and monitoring wells.

- Focus any agrichemical studies on shallow groundwater beneath agricultural fields and collect samples from nearby domestic wells rather than adjacent to canals, drains, and ensure adequate data are collected regarding timing and rate of chemical application.

- Do not expand the program to the North Valley without an initial reconnaissance of surface water to determine if such a program is warranted due to the presence of contaminants.

With respect to status and disposition of the existing wells and surface locations:

- Extend the MRGCD license and retain a portion the wells for water level monitoring transects in conjunction with on-going USGS studies, particularly along Rio Bravo Blvd..

- Determine whether the Barr Drain surface location and related shallow groundwater monitoring wells are applicable locations for monitoring of stormwater quality runoff of surface water discharges. If so, modify the program to address stormwater quality parameters and flow rate monitoring as allowed by the MRGCD license agreements for those locations. Monitoring at the San Jose Drain site, the Los Padillas Drain site, and the Albuquerque Drain site should also be evaluated for applicability of continued monitoring.

- For retained locations, establish elevations to within 0.01 feet at wellheads and monitor elevation changes in canals and drains and related responses in the adjacent wells. Install pressure transducers in the wells, and if feasible establish stage recorders in the adjacent canals and drains.

- Identify County projects that may benefit from retention of wells in other locations such as future locations of detention or storm surge ponds, establish elevations at wells heads, and continue to monitor water levels at those locations.

- For the remainder of the wells, plug and abandon the locations per MRGCD license agreements.

1.0 Study Area and Background

The South Valley area of Bernallilo County encompasses the area from Central Avenue to the Isleta Pueblo and from Coors Blvd. to I-25 and comprises approximately 39 square miles. The Rio Grande, Bosque, and large agricultural tracts of the South Valley (Figure 1.1) create one of the most attractive physical settings in the metropolitan area. For centuries, agriculture has been a traditional way of life for people of the flood plain of the Rio Grande and the South Valley maintained itself as a nearly self-sufficient agricultural community until the early 1940's. Recently, the amount of agricultural acreage has declined due to the conversion of land from agriculture to residential, commercial and manufacturing uses.

Within the South Valley, the northern urbanized neighborhoods merge into the more semi-urban, and agricultural areas farther south. Within the South Valley 1,679 parcels of property receive irrigation water from the Middle Rio Grande Conservancy District (MRGCD) although less than 3% of landowners own parcels of agricultural land that are larger than 40 acres. Large, production-scale tracts of agricultural properties currently exist near the intersection of Coors Blvd. and Rio Bravo Blvd.; between 2nd Street and the Rio Grande south of Rio Bravo Blvd., and between Coors Blvd. and the Rio Grande south of Pajarito Rd. Production-scale agricultural uses in the South Valley have historically included dairies and feedlots. Crops have been largely alfalfa, intended as feed for the dairies. As the dairy industry has declined, the demand for feed has also declined.

Agriculture fields in the South Valley are sustained by irrigation water from the drains and canals of the MRGCD. The shallow hydrology of this area is complicated by the interaction of surface and groundwater along numerous irrigation and drainage channels and the Rio Grande. Ground water is the primary source of domestic water for all households in the South Valley and Southwest and Southeast Mesa whether they get water from their own wells, from shared wells or from municipal systems. The aquifer in the inner valley area is very susceptible to contamination because the water table is shallow. Depth to the seasonal high water table ranges from ten to thirty-five feet over much of the inner valley.

Recognizing this vulnerability, the City of Albuquerque (CABQ) and the Bernalillo County's resolution to protect their shared groundwater resources is documented in the *Groundwater Protection Policy and Action Plan* (GPPAP), with implementation occurring through the Joint Administrative Directive (JAD). With regard to agricultural practices, the GPPAP states the City and County are to "monitor groundwater and drains to assess potential impacts to groundwater". The JAD assigns responsibilities for identifying control programs and whether the programs are to be conducted jointly or individually by the City or County. The JAD assigns Bernalillo County with the responsibility of assessing the potential affects of agricultural practices on the groundwater resources of the county and for coordinating and developing a plan for the monitoring.

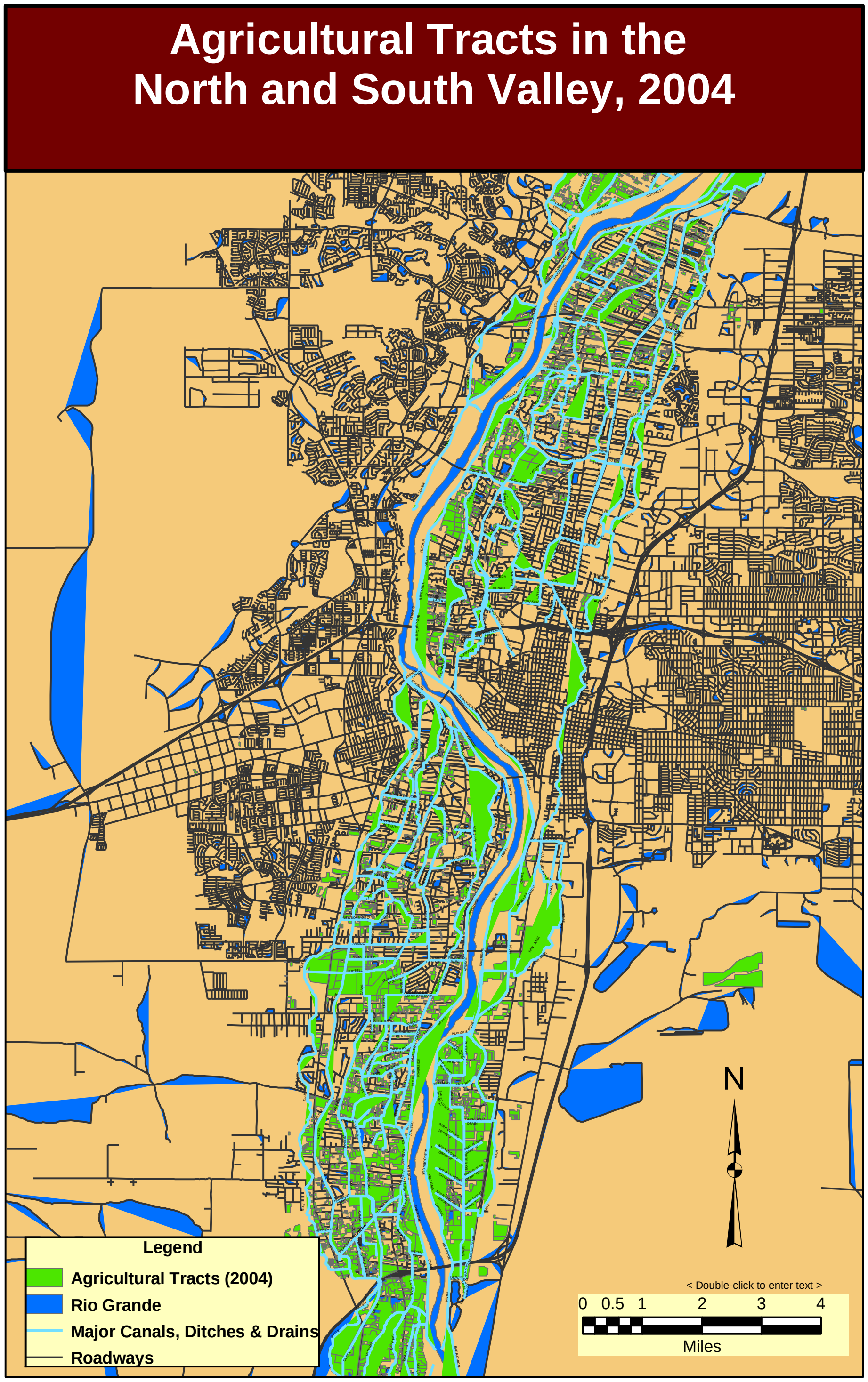


Figure 1.1 Agricultural Tracts in Bernalillo County

In April 2001, the Bernalillo County Environmental Health Department (BCEHD, and predecessor to Bernalillo County Office of Environmental Health), proposed development of an "agricultural waste impact monitoring program" along the Rio Grande. Accordingly, this study focuses on the potential shallow groundwater water-quality impacts of present-day agrichemical use.

1.1 Initial Proposals and Programs

Rick Shean with BCEHD prepared an initial proposal for a monitoring program in April of 2001 as a professional project within the University of New Mexico's (UNM) Water Resources Program. The initial stated purpose of the proposal was to:

> Develop an agricultural waste monitoring program for Bernalillo County along the Rio Grande that will conform with regional, local, and conservancy district planning using existing agricultural waste assessments, water quality data, surface and groundwater interaction estimates, and hydrological and geo hydrological data.

The proposal included a large scope of activities including gathering data on agricultural land and chemical use and practices, determination of diversion and return flow quantities, modeling of agricultural waste fate and transport, and developing a water budget and flow model for the valley area shallow aquifer, all within a one year time frame. There is no indication that the proposal came to fruition under the UNM program.

During FY01-02, however, BCEHD encumbered an initial $75,000 of GPPAP funding to implement a program closely paralleling the original proposal. The stated purpose of the program, as funded, was:

> Determination of both existing levels of agricultural waste products (pesticides, herbicides, fertilizers and fecal coliform) in shallow ground and surface water in the South Valley area of Bernalillo County, and assess shallow groundwater and surface water interaction.

1.2 Related USGS Studies and Proposals

The South Valley has been the focus of numerous reports and investigations by the New Mexico Environment Department (NMED), the United States Environmental Protection Agency (U.S. EPA) and the United States Geological Survey (USGS). Studies by the NMED and the U.S. EPA have typically been focused on hazardous waste releases and contamination issues and on specific locations or release area rather than on the impact of agricultural practices and surface water / shallow groundwater interaction. Three USGS studies are of particular relevance to this study

1.2.1 USGS Report: WRIR 97-4067

(Scott Anderholm, 1993. *Water Quality Assessment of the Rio Grande Valley, Colorado, New Mexico, and Texas – Shallow Ground-Water Quality and Land Use in the Albuquerque Area Central New Mexico*, U.S. Geological Survey Water-Resources Investigations Report 97-4069.)

As part of the National Water-Quality Assessment Program (NWQA), the USGS in 1993 conducted shallow groundwater sampling at 24 locations in the valley area, with locations covering an area just north of the Sandoval County line and extending southward to the I-25 / Rio Grande bridge, and between Coors Blvd. to the west and I-25 to the east. Site locations were selected using a computerized-stratified-random sampling technique. Well records within the selected locations were reviewed to ensure that 1) the well screened only the upper 10 to 15 feet of the zone of saturation, 2) well materials were either stainless steel or PVC, 3) the well was used only for monitoring, and 4) the well was not located in an area of known local contamination. Only five existing wells met those criteria. The USGS installed additional wells as needed. Sites 1 through 5 and 7 through 9 were located in the South Valley. In July through September 1993, the USGS sampled the wells for "selected common constituents, nutrients, dissolved organic carbon, trace elements, radionuclides, volatile organic compounds (VOCs) and pesticides." The wells were purged of three casing volumes, and samples were collected using a portable submersible pump.

The results of these analyses for samples collected in 1993 and reported by the USGS in 1997 indicated that volatile organic compounds were detected in 5 of 24 samples, with Cis-1,2-dichlorethene and 1,1 dichloroethane being detected in two samples each. Pesticides were detected in 8 of the 24 samples, with Prometon being the most common and detected in 8 of the 24 samples. Barium, iron, manganese, molybdenum, and uranium were the only trace elements analytes that had media concentrations greater than 5 micrograms per liter. Concentrations of nutrients were generally less than 1 milligram per liter, and the concentration of most of the trace elements were below or only slightly above 1 microgram per liter (ug/L)

The compounds Prometon and Atrazine are commonly used herbicides, Carbaryl is an insecticide used in multiple insecticide products and sold under the trade name of Sevin. P-isopropyltoluene is not an agricultural chemical. The reported concentrations were at least two orders of magnitude less than equivalent EPA limits or reference doses.

In samples from the South Valley sites, total nitrogen concentrations (as N) ranged from <0.05 to 2.8 mg/L and phosphorous ranged from <0.01 to 0.40 mg/L. The USGS (Water Supply Paper 2254, p. 128) cites references suggesting that total dissolved inorganic phosphate concentrations (as P) in river water should average about 0.01 mg/L (10 ug/L) and total dissolved phosphate about 0.025 mg/L (25 ug/L). The analysis results do not indicate any abnormally high concentrations of either of these two constituents, which are a primary component of agricultural fertilizers.

Organic compounds found in the samples from the South Valley wells included the following:

Table 1.1 South Valley Organic Compound Detections from the 1993 NWQA Study

Location Number	General Location	Detected Compound	Reported Conc. (ug/L)	Regulatory Standards*
2	Atrisco Drain south of Don Felipe Rd.	P-isopropyltoluene	0.4	No Data Available
4	Isleta Drain north of Harris Rd.	Atrazine	0.016	SDWA: 3 ug/L
3	Arenal Main Canal near Sunshine Rd.	Prometon	0.16	Oral RfD: 0.015 mg / kg_{body}/ day (≈ 17 ug/L)
5	Isleta Drain at the Pajarito Lateral	Prometon	0.005	Oral RfD: 0.015 mg / kg_{body}/ day (≈ 17 ug/L)
7	Atrisco Riverside Drain near Valle del Sol Rd..	Carbaryl	0.005	Oral RfD: 0.1 mg / kg_{body}/ day (≈113 ug/L)

* SDWA – Safe Drinking Water Act
RfD – Reference Dose taken from EPA IRIS database. Conversion to water concentration assuming body weight of 100 lbs (45.4 kg) and consumption of 4 liters of water per day.)

The USGS surmised that infiltration of surface water and the evaporation or transpiration of irrigation water was partially the result of past and present agricultural land use and seemed to affect the concentrations of common constituents in the shallow groundwater study area. The USGS also noted that infiltration of septic-system effluent from residential land use had affected the shallow groundwater compositions in parts of the study area. Although the presence of synthetic organic compounds was noted and indicates impact from human activities, determining the relationship between the type of land use and the presence of particular synthetic compounds was not possible.

The NWQA program is on-going and wells and additional sample locations in the South Valley were added to program as of November 2005.

1.2.2 USGS Report: WRIR 01-4069

(D.M. Roark, 2001, *Estimation of hydraulic characteristics in the Santa Fe Group aquifer system using computer simulations of river and drain pulses in the Rio Bravo study area, near Albuquerque, New Mexico*: U.S. Geological Survey Water-Resources Investigations Report 01-4069.)

In 1977, the USGS conducted a hydrologic investigation of the Rio Grande and the surrounding alluvium and the Santa Fe Group aquifer system in an area near the Rio Bravo Bridge. Wells were installed and equipped to monitor water levels in a transect perpendicular to the Rio Grande on the east side of the river. Equipment to measure stream stage was installed at two sites, on the Albuquerque Riverside Drain and on the Rio Grande. A short duration river pulse and a long-duration river pulse were used to stress the groundwater system. Computer modeling was used to simulated the hydrologic response. Simulated horizontal hydraulic conductivities varied from 0.03 to 100 feet per day, and vertical hydraulic conductivities varied from 1.5×10^{-6} to 0.01 feet per day. The specific yield from the upper most layer of the model was estimated to be 0.3, and lower layers were estimated to be approximately 1.0×10^{-6} (p.1).

1.2.3 USGS Investigation: Data Collection at Selected Locations on the Rio Grande River

In 2003, the USGS approached Bernalillo County with a proposal to install 20 monitoring wells in the South Valley area from Central Street south to the Pubelo of Isleta and within the historic Rio Grande Flood Plain. The wells were to be used to obtain shallow groundwater levels with the South Valley area. The data were to be used, primarily, by the Bureau of Reclamation and the U.S. Army Corp of Engineers to develop groundwater / surface water interaction data sets for input into the Upper Rio Grande Water Operations Model. No further action was taken on the proposal by the County.

Regardless, the USGS obtained funding to install a series of deep and shallow transects within the Rio Grande floodplain. In 2003, a cross section was established at the Rio Bravo Bridge and at other transect locations. Groundwater-levels from these sites are currently available and can be accessed on-line at http://nm.water.usgs.gov/bosque.html. The USGS transects at Rio Bravo Bridge and the I-25 bridges provide overlap in coverage with the transects installed and monitored as part of the agrichemical water-quality impact study. During 2004 and 2005, additional cross sections were established in the Albuquerque area. Cross-section locations now include the Alameda, Paseo del Norte, Montano, I-40, Central, Barelas, and I-25 Bridges. From 2005 to 2007, additional cross sections are to be established from Cochiti Dam to Bernalillo, I-25 to Bernardo, and Bernardo to San Acacia.

1.3 Surface Water Monitoring for Acequias Located Within Bernalillo County, 2005

Surface water monitoring for acequias located within Bernalillo County was done as a collaborative project between the Bernalillo County Office of Environmental Health, New Mexico Environment Department (NMED), Surface Water Quality Bureau, and the South Valley Partners for Environmental Justice (SVPEJ). Surface water monitoring was performed in response to the testimony provided by South Valley community residents on changing surface water quality standards from secondary to primary contact for the reach of the Rio Grande running through Bernalillo County. The Water Quality Control Board subsequently implemented the change from secondary to primary contact standards during the Triennial Review process.

Samples were collected from eight sites selected by community organizers living in the South Valley who were knowledgeable regarding the location of acequias that experienced the greatest amount of illegal dumping, and therefore represented a worst case scenario. The samples were collected according to EPA approved quality assurance/quality control protocols. Samples were analyzed by an EPA approved laboratory, the State Laboratory Division of the New Mexico Department of Health.

Of the eight sites sampled, the San Jose Drain site, the Los Padillas Drain site, and the Albuquerque Riverside Drain site exceeded the New Mexico Administrative Code surface water quality standards for *E. Coli* in the fall, while the San Jose Drain site also exceeded the *E. Coli* standard in the spring.

Based on the surface water quality standards for dissolved aluminum, antimony, arsenic, boron, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, thallium, vanadium, and zinc, the San Jose Drain site was also found to exceed the standard for dissolved mercury in the fall.

There were no exceedances of any of the semivolatile organics tested based on the surface water quality standards. Soil samples collected from San Jose Drain site did exceed the reference dose (RfD) levels set by the EPA Integrated Risk Information System for three of the semi-volatile organic compounds. These include Bis(2-Ethylhexyl)phthalate, Fluoranthene, and Pyrene. However, none of the soil samples collected exceeded the health based screening levels established by the NMED Hazardous Waste Bureau, the NMED Ground Water Quality Bureau Voluntary Remediation Program, and the NMED Superfund Section.

A more detailed description of this project and summary of results was prepared by the staff of the Bernalillo County of Environmental Health are provided in Appendix A of this report

1.4 Middle Rio Grande Microbial Source Tracking Assessment Report

The Middle Rio Grande Microbial Source Tracking Project was funded by the New Mexico Environmental Department, Albuquerque Metropolitan Arroyo Flood Control Authority, and Bernalillo County. The objective of the project was to identify specific sources of fecal coliform causing high levels of bacteria in the Middle Rio Grande area between Angostura Diversion Dam in southeastern Sandoval County to the Isleta Diversion Dam, at the northern border of the Isleta Pueblo.

A fecal coliform total maximum daily loads (TMDL) for the Middle Rio Grande was approved by the U.S. Environmental Protection Agency (U.S. EPA) Region 6 in May 2002. The TDML identified several potential sources of fecal bacteria in the Middle Rio Grande. The TMDL document indicates that septic systems and failures in sanitary sewer systems do not appear to be a large contributor to the elevated fecal coliform levels in the Middle Rio Grande. Nonpoint source runoff is identified as the likely major contributor to fecal coliform contamination. Of concern is nonpoint source runoff of storm water contaminated by livestock, wildlife, and other domestic animals, and discharged to the river through arroyos and drains.

Of interest to the agrichemical water-quality impact study is any contamination due to livestock evidenced at the subwatershed surface water sampling locations that correlate to the study

locations. For the entire study area, the relative percent of fecal coliform attributable to livestock does not change more than 1 percent between runoff and non-runoff conditions.
A summary of the findings is provided in Table 1.2 and indicates that fecal contamination from livestock (principally bovine and equine) is a notable contributor to the total fecal contamination load of the Middle Rio Grande.

Table 1.2 Summary of Microbial Source Tracking Assessment Report

Sample Location	Fecal Coliform Counts Runoff / *Non-Runoff* (Geo. Mean / Min / Max) cfu / 100 ml	# Samples Collected - Runoff / *Non- Runoff*	Percent of Isolates Attributable to Livestock - Combined (Total / Bovine / Equine)	Percent of Isolates Attributable to Livestock Runoff / *Non-Runoff* (Total / Bovine /Equine)
Entire MRG Study Area	4970 / 27 / 1,040,000 *28 / <10 / 712*	172 / *34*	13.7 / 7.2 / 4.3	13.7 / 7.2 / 4.4 *13.8 / 6.9 / 3.4*
Rio Grande at the Rio Bravo Bridge	2320 / 64 / 650,000 *22 / 9 /135*	7 / *3*	20.5 / 11.4 / 4.5	20.5 / 11.4 / 4.5 *Insufficient Data*
Rio Grande at the I-25 Bridge	4610 / 490 / 360,000 *412 / 189 / 684*	8 / *3*	17.4 / 9.4 / 4.7	12.2 / 8.1 / 2.7 *22.7 / 10.7 / 6..7*
Amole del Norte Channel	20,000 / 40,000 / 80,000 *Not Sampled*	2 / *0*	14.3 / 4.8 / 9.5	14.3 / 4.8 / 9.5 -- / -- / --
Los Padillas Drain upstream of Isleta Drain	253 / 36 / 2,600 *Not Sampled*	8 / *0*	16.7 / 16.7 / 0	16.7 / 0 / 16.7 -- / -- / --
Isleta Drain upstream of Las Padillas Drain	2,100 / 200 / 420,000 *Not Sampled*	9 / *0*	17.3 / 4.3 / 4.3	17.3 / 4.3 / 4.3 -- / -- / --

Location Notes:

Rio Grande at Rio Bravo Bridge – In addition to the watershed contributing from upstream, the MRG's watershed at this point includes Corrales, Rio Rancho, and most of Albuquerque on both banks, including portions draining to the Alameda Drain, the Lower Corrales Riverside Drain, and several arroyos. The human population density of the contributing watershed is 275 per square mile, and 4.7 percent of the watershed is developed land. The number of households in the watershed served by public sanitary sewer declines from 95 percent to 92 percent between these two sites.

Rio Grande at Interstate 25 - This site is approximately 6 miles downstream of the Rio Bravo Bridge. However, the contributing watershed is almost the same as that at Rio Bravo, as no significant tributaries discharge into the river in this reach. The possible exception is the Tijeras Arroyo which discharges to the Rio Grande above Interstate 25. The South Diversion Channel discharges to the Tijeras Arroyo. The City of Albuquerque Wastewater Treatment Facility discharges to this reach of the Rio Grande. A permitted concentrated animal feeding operation (CAFO) is located within this watershed on the east side of the river. The CAFO is a dairy located west of Highway 47 and south of Mountainview.

Amole del Norte Channel above Amole Dam – The watershed of this southwestern drainage way is primarily grassland, and the population density was only 70 persons per square mile in 2000.

Los Padillas Drain just upstream of the confluence with the Isleta Drain – Draining a 5 square mile watershed south of Albuquerque and just west of the Rio Grande, this watershed comprises a mixture of residential and cropland uses. Cropland composes a larger portion of the watershed (35%) than any other watershed investigated in this study. Almost 4 percent of the households reported farm income in 1990. Only
37 percent of the households were served by public sanitary sewers in 1990, and the density of septic tanks was 239 per square mile.

Isleta Drain just upstream of the confluence with the Los Padillas Drain –
Draining an approximately 60 square mile watershed mostly southwest of Albuquerque and adjacent to Los Padillas Drain, this watershed is much less developed than that of Los Padillas. Cropland and developed land are less abundant in the Isleta Drain

watershed, and shrubland and grassland are the major land covers. Eighty percent of the households in the watershed reported in 1990 that they were attached to public sewer systems.

1.5 Analogous Study at Las Nutria

(Bowman and Henrdickx, 1998. *Determination of Agricultural Chemical Impacts on Shallow Groundwater Quality in the Rio Grande Valley: Las Nutria Groundwater Project.* WRRI Technical Completion Report No. 308)

A brief literature review for this report uncovered a similar study published in 1998 by Bowman and Hendrickx The study involved a comprehensive assessment of water and chemical relationships at a commercial farm in the central Rio Grand Valley. The study site was a highly instrumented 15-acres tile-drained field and the study focused on determining averaged data on recharge rates and nitrate and pesticide leaching to shallow groundwater.

Conclusions of the study state that nitrate leaching did not appear to create a major or persistent problem with regard to shallow groundwater quality. Nitrate concentrations in excess of 10 mg/L persisted for only a short period immediately following a flood irrigation event during the 1994 irrigation season. Samples collected at the outfall never exceeded the nitrate standard.

With respect to pesticides, the conclusions state that no pesticides were detected in the tile drain water at any time over a two-year sampling period. Analysis included 1,2-dibromoethane (EDB), 1,2-dibromo-3-chloropropane (DBCP); acid herbicides, synthetic organics, carbamate pesticides, and aromatic and halogenated purgeables. Intensive groundwater and tile drain sampling was also conducted for chloripyrifos (Lorsban) in 1995 and dimethoate (Dimate 4E) in 1996. A few groundwater samples contained trace amounts (0.1 to 1 ug/L) of chloripyrifos; no dimthoate was detected in any sample. Application rates were 1.5 pints per acre for chlropyrifos (40.7% by weight) in 1995 and 0.75 pints per acre for dimethoate (4 lbs dimethoate per gallon) in 1996, with applications made in mid-April.

The conclusions clearly state that “based on the information collected during Las Nutrias Groundwater Project, typical agricultural cropping, water, nutrient, and pesticide management practices do not appear to pose a broad threat to shallow groundwater in the Rio Grande Valley. Due to large dilution by ambient groundwater … temporary spikes in field drainage chemical concentrations are rapidly diluted below regulatory levels.”

2.0 Scope of the South Valley Agrichemical Water-Quality Impact Study

In April 2001, the BCEHD proposed development an “agricultural waste impact monitoring program” along the Rio Grande. The purpose of the program was to develop a plan to conform with regional, local, and conservancy district planning using existing agricultural waste assessments, water quality data, surface and groundwater interaction estimates, and hydrological and geohydrological data. Continuation of the program was transferred to Bernalillo County Public Works at the time of the County's structural reorganization.

The associated Scope of Work for the project included developing a network of sampling points within the groundwater drains in the South Valley, collection of samples along three transects with sampling occurring twice during irrigation season and three subsequent sampling events during the fall, spring, and early summer. The scope was also to include developing a catalog of agricultural activities with the county, including inventories of water diversion rights, crop production, and estimated herbicide and pesticide use, with the stated intention of creating a model of agricultural waste migration for the South Valley. The planned report was to address the creation of the sampling network, data analysis and presentation, a network analysis, monitoring network recommendations, best management practice recommendations, and evaluation and recommendations of the sampling program. The focus of the project was a regional, rather than site specific, assessment of the impact of agricultural practices. The South Valley was selected for the initial pilot project due to historical contamination problems, high density of residents dependent on individual wells, and density of agricultural land use.

2.1 Sampling Location

The agricultural waste monitoring network consists of a total of forty-five surface water and shallow groundwater sampling locations located in the South Valley. The sampling locations are located in three transects, with sampling locations in or adjacent to irrigation canals and drains on MRGCD property. These three transects include surface water sites at the inlets to canals and drains near the Rio Grande in the north part of the South Valley, and surface water and adjacent monitoring well locations in transects along Rio Bravo Blvd., and along Malpais Rd. The sampling locations were selected to capture background concentrations of Rio Grande water supplied for irrigation and for determining contaminant concentrations in waters draining from agricultural fields and in groundwater.

Figures 2-1 through 2-4 plot the location of the various sampling points used for this sampling program. The location naming convention uses the prefix to denote the transect: "B" indicating baseline stations near the Rio Grande, "RB" denoting the transect parallel to Rio Bravo Blvd., and "M" denoting locations along Malpais Rd. Location names ending in "S"or "SURF" denote a surface water collection sites regardless of whether they be canals or drains, and those ending in "G" denote a shallow groundwater monitoring well. The numeric designator indicates order of installation and generally increases from west to east. Samples have also been collected from dewatering activities at the intersection of the Isleta Drain and Rio Bravo, and along Pajarito Rd. approximately ½ mile east of Coors Blvd..

Surface water sampling points were chosen at the diversion points into the canal system, in proximity to agricultural fields, and from drains. A license agreement was obtained from the MRGCD in 2002 and wells were subsequently installed along canals and ditches within the MRGCD right-of-way. Rodgers and Co., Inc. was contracted in September, 2003 to install twenty (20) drive-point type shallow groundwater monitoring wells. The wells were constructed during the period of September – December 2003. Wells were pushed/driven to a depth of approximately fifteen (15) feet below ground surface using 10-feet of blank galvanized casing and 5 feet of slotted galvanized screen. The wells were completed below grade and provided with locking caps and flush-mounted bolted monitoring well covers and concrete pads. In most cases, wells were paired, with one well on the upstream side of the surface water sampling point, and one on the downstream side. No wells or sampling points were placed within the boundaries of privately-owned agricultural plots or in areas of known contamination from other sources.

2.2 Sample Collection and Analysis

Water samples were collected during the period of 2001 to 2005 and analyzed for a constituent list useful for detecting and characterizing agrichemicals. The composite list included pesticides, and herbicides, nutrients (nitrates, ammonia, total Klejdhal nitrogen (TKN), chloride, sulfate and total dissolved solids, and selected metals (chromium, arsenic, iron and manganese).

Sampling events were chosen to capture seasonal water table fluctuations, agricultural chemical application seasons, and pre- and post- irrigation seasons. Initial surface water samples were taken in October 2001 and September of 2003, and both surface water and groundwater samples were taken in December-January 2004, July 2004, March 2005, June 2005, and September 2005. Due to laboratory scheduling constraints, samples were typically collected over a two to three week interval. Samples were collected, field preserved, cooled, and typically delivered by hand on the day of collection.

2.2.1 Analyte List

Production-scale agriculture often utilizes a variety of agrichemicals to boost productivity and increase yield and quality. Agrichemical (or agrochemical), a contraction of *agricultural chemical*, is a generic term for the various chemical products used in agriculture. In most cases, agrichemical refers to the broad range of pesticides, herbicides, and fungicides, but it may also include synthetic fertilizers, hormones and other chemical growth agents, and concentrated stores of raw animal manure. The misuse or mishandling of these chemicals and synthetics has the potential to adversely impact surface and groundwater quality.

For the Scope of Work funded in 2003, the analyte list consisted of the following:

- Base/Neutrals and Acids (BNAs)
- Fecal Coliform
- Nitrates + Nitrite
- Total Kjeldahl Nitrogen (TKN)
- Chloride
- Total Dissolved Solids (TDS)
- Sulfate
- Chromium
- Iron
- Lead

As sampling progressed, the analyte list was modified to ensure that all appropriate compounds (e.g. surfactants and volatile organic compounds) were analyzed.

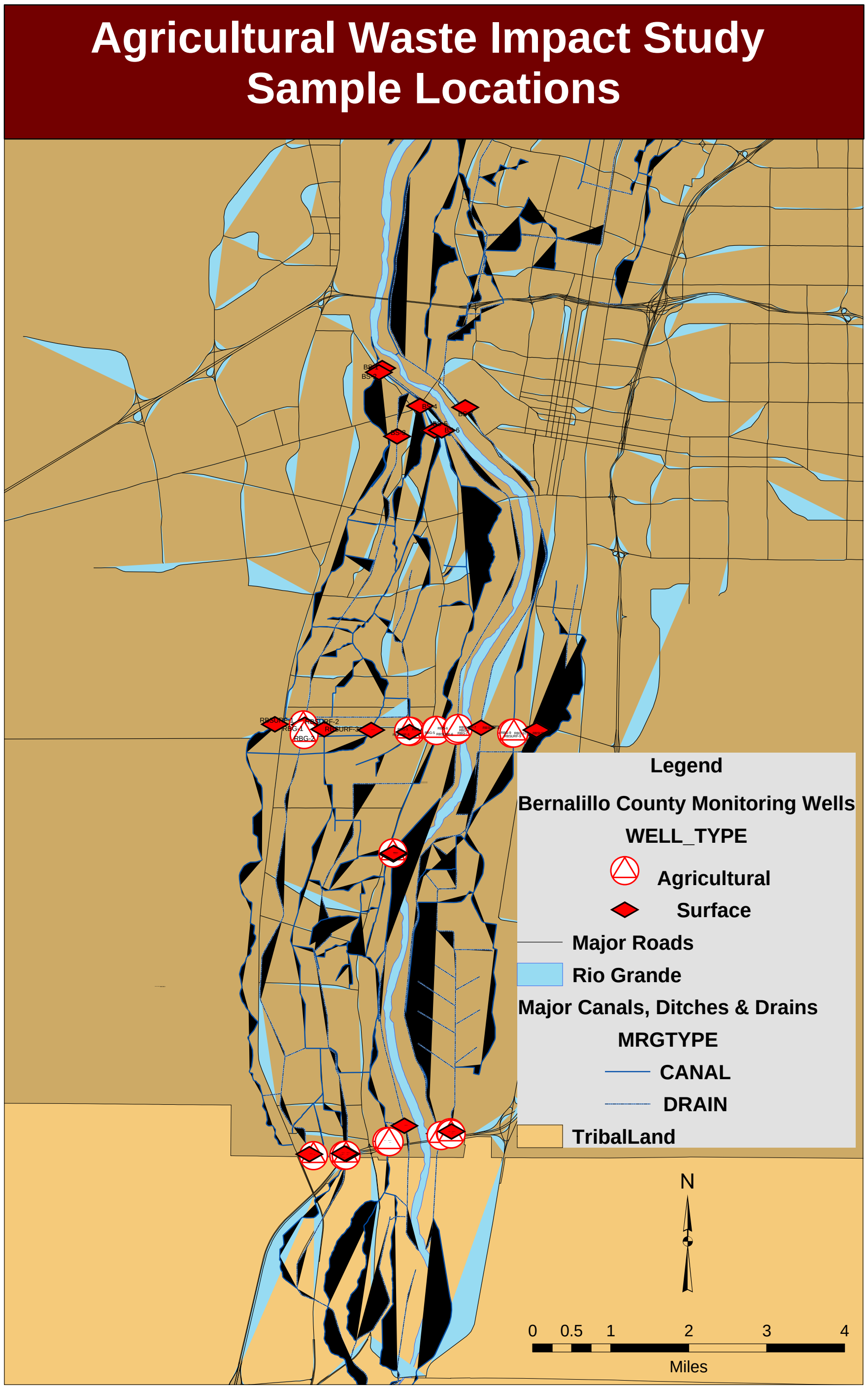


Figure 2.1 Overview of Sampling Locations

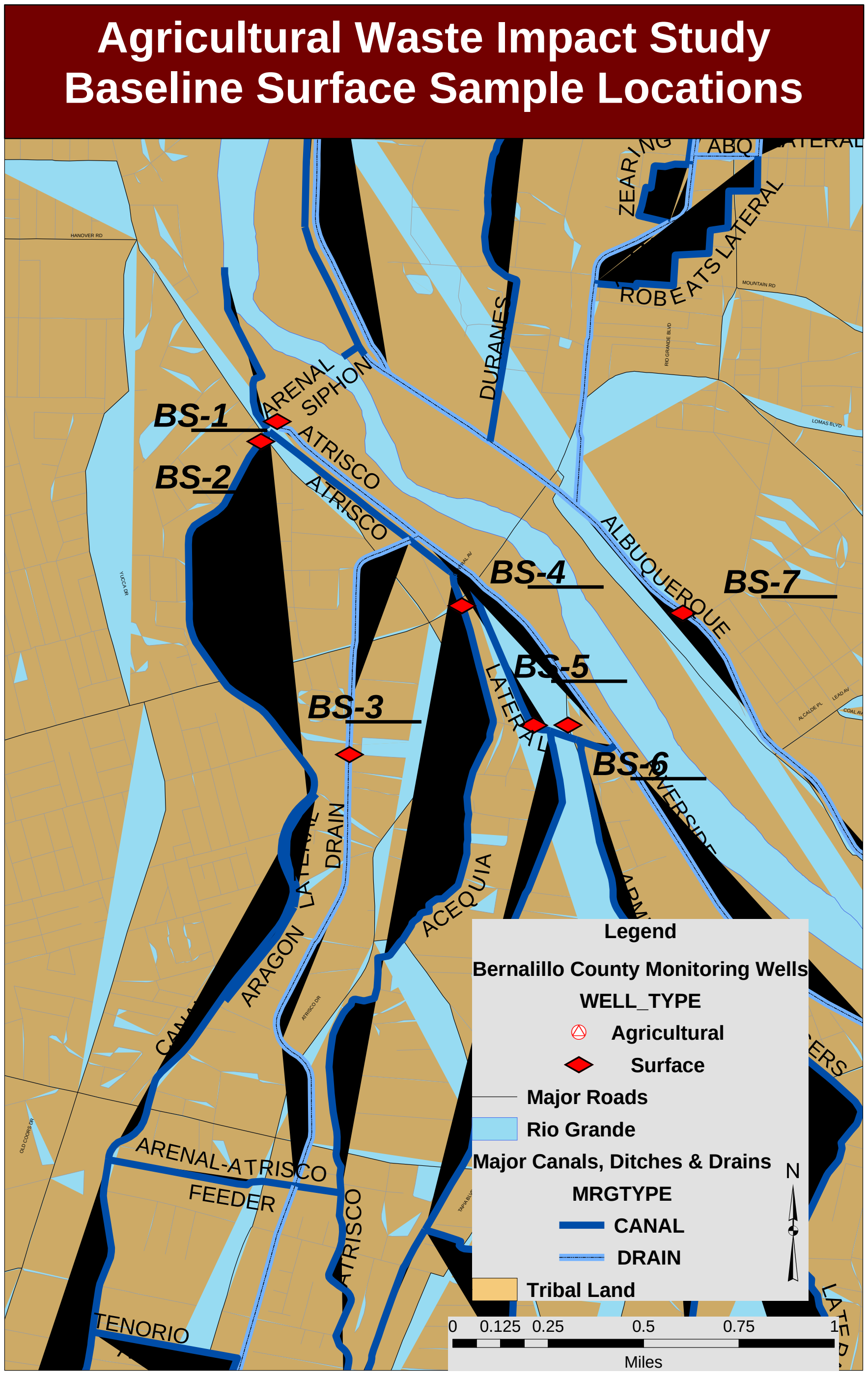


Figure 2.2 Headwater Transect Sampling Locations

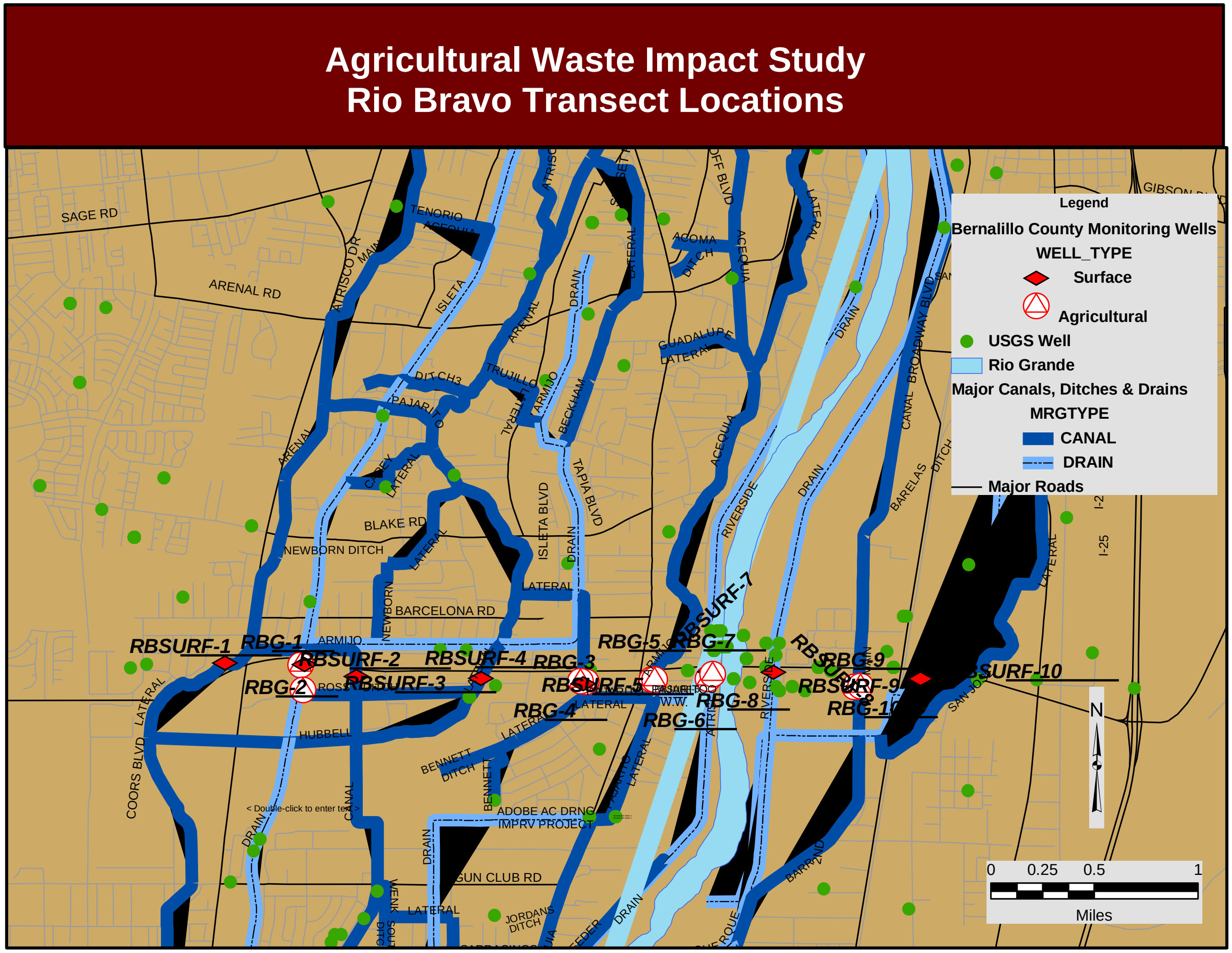


Figure 2.3 Rio Bravo Transect Locations

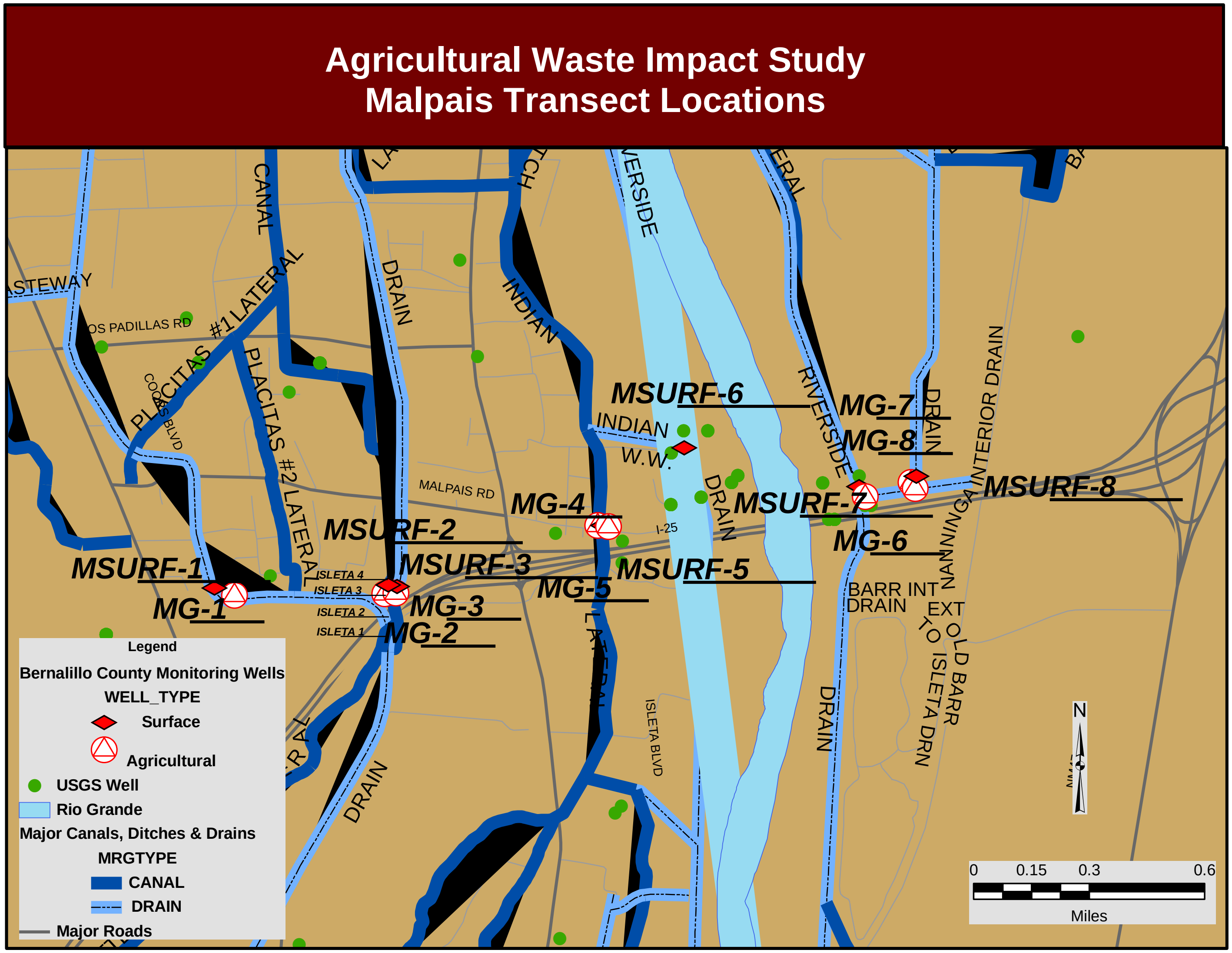


Figure 2.4 Malpais Transect Sample Locations

2.2.2 Sampling Events and Methods

Initial sampling of surface water locations occurred in October 2001 and again in September 2003. Groundwater monitoring wells were first sampled in December 2003 - January 2004. Starting in 2004, each sampling event retrieved samples from all accessible groundwater monitoring wells, with the exception of MPG-8 which was destroyed during MRGCD maintenance activities. Each surface water location was checked, and if water was present a sample was collected. In many instances, the drains were dry and samples could not be obtained.

Surface water samples were collected using grab sampling techniques. The samples were collected by BCEHD personnel for the October 2001 and September 2003 sampling events. Existing records do not explain the two year delay in sampling events.

The first groundwater samples were collected during the winter of 2003-2004 by BCEHD personnel. No surface water samples were collected during this sampling event. Existing records do not explain the lack of surface water sampling at that time. There are no records indicating what method was used to collect the samples. Presumably, they were hand-bailed. This sampling event represents a post-irrigation season sample of the groundwater.

Only groundwater samples were collected during July 2004. The samples were collected by a County contractor. The wells were purged and subsequently sampled using disposable bailers. Contract requirements and field notes indicate that the wells were purged of only one casing volume prior to sampling and that the pH, temperature and conductivity were measured. A review of the field notes indicates that pH had not stabilized after one volume, though temperature and conductivity had stabilized. The pH readings indicated a continuing decrease in pH with successive measurements. The total change from the initial measurement was at least 0.3 units in most cases and as great as 0.5 units in one case. The difference in successive pH measurements immediately prior to sampling was in some cases larger than 0.1 units. Typical well sampling practice is to purge three casing volumes and/or demonstrate three successive pH measurements within 0.1 units. These samples, if representative, reflect mid-season irrigation conditions.

Starting in March 2005, the County elected to resume sampling utilizing County personnel. The field protocol was changed to ensure that at least three well volumes were purged prior to sampling. However, field parameters were not measured. Samples were collected from all serviceable groundwater wells and from all surface water locations containing sufficient water. Samples were collected in March 2005 to represent pre- irrigation season conditions. Additional samples were collected in June-July 2005 and again in August-September 2005. The timing of these events was intended to capture the range of conditions occurring during the early and late irrigation seasons.

Subsequent groundwater samples were taken at two construction dewatering locations. The amount of time and volume of pumping preceding pumping is unknown, but the systems were in operation for at least three days prior to sampling. These samples were taken due to proximity to large agricultural acreages near the intersection of Rio Bravo and Coors Blvd. and near Pajarito and Coors Blvd.. Additional dewatering samples are currently planned during sewer and water line installation throughout the South Valley.

2.2.3 Field Documentation / Quality Control

A brief review of field documentation and quality control documentation has been conducted for each sampling event to ensure representativeness of the samples and to ensure comparability of samples over the period of record. After the 2004 sampling events, the level of field documentation was increased. Though not a regulatory or program requirement, chain-of-custody forms were completed and preservation of samples was noted.

2.2.3.1 Initial Sampling Events

The first round of surface water samples was collected in October 2001 and September 2003 and during Winter 2003-2004 for groundwater samples. Field documentation of the sampling events was not found during the file review. Analytical results and the analysis request form are available.

The analytical request form includes information relevant to chain-of-custody issues such as sample date and time, personnel, and sample preservation methods. These analysis requests sheets indicate that samples were delivered to the contract laboratory (State Laboratory Division –SLD) either on the day of collection or on the following day.

The semivolatile organic compound (SVOC) analyses reports indicate that extractions and analysis were conducted within hold times and the only notations of “flags” for the analyses were for the detection of various phthalate compounds. Phthalates are a known laboratory contaminant. Some analyses also noted that surrogate recoveries were low, suggesting potential for negative reporting errors for the related compounds. However, most recoveries were within normal ranges. The analysis requests sheets either lack indication of any preservation methods (in this case, chilling) or indicate chilling. However, documentation for SVOC analysis indicate all samples were received at temperatures below 10C, indicating at least chilled storage of the samples prior to delivery to the laboratory.

Trace metal analysis are available for only a very few of the samples from the initial events. The analysis requests sheet indicate that the samples were not filtered, nor were they field acidified. The analytical sheets however indicate that the samples were acidified in the laboratory. In most cases, matrix spike recoveries were within normal bounds (80 percent to 100 percent). If outside those bounds, the data was flagged and it was noted that matrix interference was suspected. In one instance (RBS-6 on 9/29/2003) multiple trace metals were flagged as having relative percent differences of greater than 10 percent for aluminum, boron, iron, and manganese. All trace metal analyses were conducted within the 6 month hold time.

The analysis requests sheet for the nutrient-series analysis generally indicate that the samples were field preserved with H_2SO4 and chilled per appropriate sampling protocols for the samples collected in 2001. Analysis request sheets for samples collected in 2003 indicate that no field preservation occurred. The analysis request sheets however indicated that the samples were acidified in the laboratory, generally within one hour of laboratory receipt of the sample. Exceptions to this do exist including the samples for MS-7 and MS-8, which do not indicate any preservation. Analysis results sheets indicate that all holding times were met.

Analysis requests sheets indicated that samples for other inorganic analysis (major anion and cation, alkalinity, total dissolved solids (TDS), and pH) were cooled and that corresponding hold times were met. However, for the cations there is no indication whether the analyses was performed on an acidified split. This is of concern because the analyses were performed some 43 days after sample collection. Comparison of results for cations that were also analyzed for the trace metals on a known acidified split generally yielded higher concentrations. Consequently, where duplication of the analysis exists (i.e. for iron and manganese), the value with the higher concentration is presumed correct. Generally this corresponds to the values reported for the trace metal analysis rather than the cation/anion analyses.

2.2.3.2 Samples from July 2004

Only groundwater samples were collected during July 2004. The samples were collected by Intera, Inc. under a negotiated County contract. Contract requirements and field notes indicate that the wells were purged of only one well volume prior to sampling and that the pH, temperature and conductivity were measured. Typical well sampling practice is to purge three casing volumes and/or demonstrate pH stabilization by measurement of three successive pH measurements, all within 0.1 units. A review of the available field notes indicate that in some cases, pH had not stabilized after purging of one volume.

A review of the Chain-of-Custodies for these samples indicated no handling abnormalities. However, neither field notes nor the chain of custodies document field preservation or filtering of metals or nutrient samples. Laboratory reports for the metals analysis however indicate that the metals samples were acidified prior to receipt by the analyzing laboratory. All bottles used for sampling were field prepped by Pinnacle laboratories. It is routine practice for this laboratory to add the appropriate preservatives as part of the bottle preparation. For evaluation purposes, it is assumed that all samples were properly preserved.

A review of the laboratory QC data indicated that all analyses were performed within control limits and that surrogate recoveries were adequate. For this sampling event, the reported minimal concentrations of total phosphorous (i.e. <1 mg/L) are flagged to indicate that the analyte was found in the method control blank. However, other samples collected from these wells at different dates do indicate the presence of minimal concentrations of total phosphorous.

2.2.3.3 Samples from March 2005 and More Recent Sampling Events

Samples collected during March 2005 and subsequent events were collected by BCPW personnel. The field protocol was changed to include bailing of a minimum of five gallons (or slightly in excess of three well volumes) prior to sampling. Field parameters were not monitored during purging. Field documentation does not indicate the preservation methods used.

However, one-to-one discussions and one round of field observations by the author indicates appropriate documentation and custody of samples were maintained, that prepared bottles contain the appropriate preservatives, and that the samples were chilled upon collection until daily delivered to the analytical laboratory. All bottles used for sampling were field prepped by Pinnacle laboratories. It is routine practice for this laboratory to add the appropriate preservatives as part of the bottle preparation. For evaluation purposes, it is assumed that all samples were properly preserved.

For the March 2005 event, laboratory certificates could only be located for a subset of the analysis including only the samples for RBG-1, RBG-2, and RBS-2. The available documentation indicates that these analyses were performed within control limits and that surrogate recoveries were adequate.

For the June 2005 sampling event, multiple samples were qualified for total phosphorous, potassium and sodium which were found in the method blank. There is one incidence of an SVOC compound (3,3'-Dichlorobenzidine, 2-fluorobyphenyl) and of potassium being outside of matrix spike or method blank surrogate control limits.

For the October 2005 sampling event, analyses were performed by two separate laboratories due to the impacts of Hurricane Katrina on the laboratory normally used for analysis. All quality control problems are associated with analysis from the alternate laboratory. These issues include: low matrix spike recovery for sulfate for samples from RBG series of wells, instances of both high and low matrix spike recovery for potassium, sample matrix interference on chromium for MG-3, MS-1, and MS-2, and excess recoveries for calcium. Problems with precision and accuracy were also flagged for magnesium. The analyses also note low recovery for foaming agents. Although the problems were flagged, results do not appear anomalous from other samples at these locations. These problems do, however, impose a limitation on determining significant statistical differences involving the October 2005 sampling event.

3.0 Results of Water Quality Analyses

The scope of the water quality analysis was previously discussed in Section 2.0. Analysis included organic compounds (herbicides, semivolatiles, volatiles, and surfactants), fecal coliform, metals, and other inorganic parameters.

3.1 Organic Compounds

3.1.1 Herbicides and Pesticides

Based on personal communications with the local New Mexico State University Agricultural Extension Agent for Bernalillo County, the commonly used pesticides/herbicides for pastures are Banvel and 2-4-D. Other pesticides that may be used include Poast, Pursuit, Sinbar, Treflan, Baylan, Buctril, Granoxon, Lorsban, and Sevine. On streambanks, the primary herbicide of choice is Roundup and Rodeo. Table 3.1 provides brief descriptive information for each of these trade name compounds. Generally, these compounds are applied at the start of the growing season using foliar application techniques. The use of these compounds is not limited to agricultural applications. As can be seen on Table 3.1, not all of the commonly used agricultural chemicals can be detected using conventional analytical methods routinely performed by most laboratories (e.g., Method 8270 for semivolatiles), and not all of the compounds listed are identifiable using the more targeted analytical techniques (Methods 8081, 8141, or 5151) that are currently available upon request. There are many classes of pesticides and herbicides (such as carbamate, organophosphates, organochloride etc.) and the differing classes of compounds have significant variations in potential health effects.

Table 3.2 indicates the sample locations for which pesticide specific analyses are available. Pesticide and herbicide analysis are available for all of the Malpais Rd. groundwater wells, and only a subset of the Rio Bravo transect wells and surface locations. All available analyses are prior to July 2004.

There were no detections for pesticides using the pesticide specific methodology. No analysis for pesticides using Methods 8081 and 8141 were run for the listed locations after the initial sampling events and no herbicide-specific analyses were performed on the initial samples. Although the pesticide specific data set is limited in number, analyses using Method 8270 are more readily available as described in the following section. Analytical results available from Method 8270 have also consistently demonstrated that the analyzable herbicides and pesticides (See Table 3.1) were not detectable at concentrations in excess of the reported detection limits for any of the sample events.

Because of the lack of pesticide and herbicide specific testing during the initial sampling events, two additional grab sample from construction dewatering wells near agricultural fields were collected during 2006 and analyzed for pesticides and herbicides using Methods 8081 (organochlorine pesticides) and Method 5151(A) (chlorinated herbicides). Consistent with the earlier results and the results of the Method 8270 analyses, no pesticides or herbicides were detected in these samples. BCPW may perform additional sampling on South Valley dewatering projects in agricultural areas to confirm these results.

The lack of detection of herbicides and pesticides in this study suggests that the USGS NGWQA reported findings are site-specific, and perhaps time-specific, and are not representative of conditions occurring over a wider area within the South Valley. Given the interval between the USGS sampling and this study and that exact locations were not duplicated, the lack of agreement can be expected. The lack of detection is also not surprising given the short half-lives of the various compounds as listed in Table 3.1. It is also possible that samples collected for this study are representative only of the surface and groundwater affected by interaction along the irrigation drainages and canals and not of groundwater conditions in outlying areas. However, the grab samples collected from dewatering systems suggest that groundwater conditions near the agricultural fields are not significantly different those at the monitoring wells.

Table 3.1 Agrichemicals in Common Use in Bernalillo County

Trade Name	Common Name / CAS Number	Listed as Detectable by Method 8270	Listed as Detectable by Method 515.1	Half-life (Hydrolysis / Aerobic Soil / Anaerobic Soil)	K_{oc}	Chemical Class
(H) 2,4-D	2,4-D 94-75-7	N	Y	39.0 / 34.0 / 333.0	45.0	Chlorophenoxy acid or esther
(H) Banvel	Dicamba 1918-00-9	N	Y	30.0 / 10.0 / 88.0	5.0	Benzoic acid
(H) Bayleton	Triadimefon 43121-43-3	N	N	1,760 / 6.0 / 23.0	364.0	Azole
(H) Buctril	Bromoxynil octonate 1689-99-2	Y	N	32.4 / -- / -- 24.2 / 2.82 /4.15 *	255.6	Hydroxybenzonitrile
(H) Gramoxone	Paraquat dichloride 1910-42-5 (Dichloride salt) 4685-14-7 (Paraquat dication)	Y	N	30.0 / 620.0 / 644.0	10,000	Bipyridylium
(H) Poast	Sethoxydim 74051-80-2	N	N	470.0 / 6.00 / 25.0	47.0	Cyclohexanone derivative
(H) Pursuit	Imazepathyr 81335-77-5	N	N	-- / 4,212 / 568	53.0	Imidazolinone
(H) Round-Up / Rodeo	Glyphosphate 38641-94-0	N	N	35 /96/ 22	6922	Phosphonoglycine
(H) Sinbar	Terbacil 5902-51-2	N	N	42 .0/ 520.0/ 48.0	0.90	Uracil
(H) Treflan	Triflualin 1582-09-8	Y	N	32.0 / 198.7 / 37.3	121.0	2,6-Dinitroaniline
(P) Lorsban	Chlorpyrifos 2921-88-2	N	N	58.1 / 113.3 / 135.5	125.2	Organophosphorus
(P) Sevin	Carbaryl 63-25-2	Y	N	12/6/87	326	N-methylcarbamate

Source: http://www.pesticideinfo.org last visited 12/2/05 *Based on related compounds only

(H) Herbicide **(P)** Pesticide

Adsorption coefficient: K_{oc}, is a measure of how strongly a chemical adheres to soil in preference to remaining dissolved in water. The California Department of Pesticide Regulation has determined that pesticides with a K_{oc} less than 1,900 have potential to contaminate groundwater.

Hydrolysis half-life: The amount of time required for half of the pesticide to degrade from reaction with water. The California Department of Pesticide Regulation has determined that pesticides with a hydrolysis half-life greater than 14 days have potential to contaminate groundwater

Soil half-life: The amount of time required for half of the pesticide to degrade in soil. This half-life is governed by the types of soil organisms that are present that can break down the pesticide, the soil type (e.g., sand, loam, clay), pH, and temperature. The California Department of Pesticide Regulation has determined that pesticides with an aerobic soil half-life greater than 690 days or an anaerobic soil half-life greater than 9 days have potential to contaminate groundwater.

Table 3.2 Available Pesticide Analyses

	October-01	September-03	December-03	January-February 04	July-04	March-05	June-05	August-September 05
BS-1								
BS-2								
BS-3								
BS-4								
BS-5								
BS-6								
BS-7								
RBS-1								
RBS-2								
RBS-3								
RBS-4	x							
RBS-5		x						
RBS-6	x	x						
RBS-7								
RBS-8								
RBS-9								
RBS-10	x							
RBG-1				x				
RBG-2				x				
RBG-3								
RBG-4								
RBG-5								
RBG-6								
RBG-7								
RBG-8				x				
RBG-9								
RBG-10				x				
MS-1	x							
MS-2		x						
MS-3	x							
MS-4								
MS-5								
MS-6								
MS-7		x						
MS-8		x						
MG-1			x					
MG-2			x					
MG-3			x					
MG-4			x					
MG-5			x					
MG-6				x				
MG-7				x				
MG-8				x				

These findings indicated that the irrigation water, drainage water and adjacent groundwater do not typically contain detectable levels of herbicides or pesticides on a study-side scale within the South Valley. These results do not preclude the existence of site-specific instances of pesticide or herbicide contamination or address conditions within areas of known contamination from other sources.

3.1.2 Semivolatile Organic Compounds (SVOCs)

The BNAs included as part of the initial analyte list include both semivolatile and volatile organic compounds. Method 8270 captures an extensive list of semivolatile organic compounds including some herbicides and pesticides as well as many other industrial and urban pollutants. Table 3.3 provides a listing of available semivolatile organic compound analyses for this study.

The October 2001 and September 2003 surface water samples, and the winter 2003-2004 groundwater samples were analyzed for semivolatile organic compounds (SVOCs) using Method 8270, though sampling of the locations occurred on an irregular basis. Samples have been more routinely collected since March 2005 and have all been analyzed for SVOCs.

A list of the compounds detected to date and the reported concentrations are provided as Table 3.4. The only detected compounds are non-agricultural and are most likely laboratory-induced contaminants, or “laboratory artifacts”. With one exception, there have been no reported detections for SVOCs other than for phthalate compounds.

Phthalates are used as a plasticizer and are a common laboratory contaminant stemming from the use of tubing and bottles for sampling and for analysis. The majority of the detections are reported from the SLD laboratory. After switching laboratories, the detection of phthalates essentially ceased. Due to the low reported concentrations, the cessation of detections after changing laboratories and the lack of repetitive detection for any given sample location, it is surmised that the reported detections are a laboratory artifact.

There is a single reported detection of 1,4-Dichlorobenzene for the 9/16/2003 sample from the MS-2 location. 1,4-Dichlorobenzene is a widely used compound in a number of household products and building materials. It is also used as a laboratory calibration standard as part of the normative QA/QC process for Method 8270. It is believed that the single incidence of this compound is also a laboratory artifact.

3.1.3 Volatile Organic Compounds (VOCs)

Volatile organic compounds include a wide range of compounds used in both agricultural and urban settings. Some of the compounds are used as carrying agents in chemical solutions. Table 3.5 provides a list of the available volatile organic compounds analyses for this project.

Due to the lack of detection of pesticides, herbicides and semivolatile organic compounds, the analyses list was expanded to include volatile organic compounds starting in July 2004. VOCs have been analyzed for all samples collected since March 2005.

There have been no reported detections of any volatile organic compounds to date. The lack of detection of volatile compounds the South Valley confirm the early reports by the USGS NWQA study wherein no volatile compounds were detected in South Valley groundwater samples.

Table 3.3 Available Semivolatile Organic Compound Analyses

	October-01	September-03	December-03	January-February 04	July-04	March-05	June-05	August-September 05
BS-1						x	x	
BS-2						x	x	
BS-3								
BS-4						x	x	
BS-5							x	
BS-6						x	x	
BS-7						x	x	
RBS-1								
RBS-2						x		x
RBS-3						x		x
RBS-4	x							x
RBS-5		x						x
RBS-6	x	x						x
RBS-7						x		x
RBS-8						x		x
RBS-9							x	x
RBS-10	x							x
RBG-1				x	x	x		x
RBG-2				x	x	x		x
RBG-3					x	x		x
RBG-4					x	x		x
RBG-5					x	x		x
RBG-6					x	x		x
RBG-7					x	x	x	x
RBG-8				x	x	x	x	x
RBG-9					x	x	x	x
RBG-10					x	x	x	x
MS-1	x					x	x	x
MS-2		x					x	x
MS-3	x					x	x	x
MS-4								
MS-5							x	x
MS-6						x	x	x
MS-7		x				x	x	x
MS-8		x				x	x	x
MG-1			x		x	x	x	x
MG-2			x		x	x	x	x
MG-3			x		x	x	x	x
MG-4			x		x	x	x	x
MG-5			x		x	x	x	x
MG-6				x	x	x	x	x
MG-7				x	x	x	x	x
MG-8				x	x			

Table 3.4 Semivolatile Organic Compounds Detections

Sample Date	Lab ID	Sample ID	Detected Analyte	Detection Limit (ug/L)	Result (ug/L)
12/17/2003	SLD OR 200303860	MG-1	bis(2-Ethylhexyl)phthalate	0.12	0.4
12/17/2003	SLD OR 200303861	MG-2	bis(2-Ethylhexyl)phthalate	0.12	0.5
12/17/2003	SLD OR 200303864	MG-3	Diethylphthalate	0.31	0.2
12/17/2003	SLD OR 200303864	MG-3	bis(2-Ethylhexyl)phthalate	0.12	2.6
12/17/2003	SLD OR 200303862	MG-4	bis(2-Ethylhexyl)phthalate	0.12	0.3
12/17/2003	SLD OR 200303863	MG-5	bis(2-Ethylhexyl)phthalate	0.12	1.2
3/8/2005	503047-01	MG-5	bis(2-Ethylhexyl)phthalate	<10	320
1/6/2004	SLD OR 200400011	MG-6	bis(2-Ethylhexyl)phthalate	0.13	0.7
1/6/2004	SLD OR 200400015	MG-7	Butylbenzylphthalate	0.32	1.7
1/6/2004	SLD OR 200400015	MG-7	bis(2-Ethylhexyl)phthalate	0.13	6.7
1/6/2004	SLD OR 200400013	MG-8	Diethylphthalate	0.32	0.6
1/6/2004	SLD OR 200400013	MG-8	bis(2-Ethylhexyl)phthalate	0.13	1.9
9/16/2003	SLD OR 200303061	MS-2	1,4-Dichlorobenzene (p-Dichlorobenzene)	0.25	0.9
9/16/2003	SLD OR 200303061	MS-2	Butylbenzylphthalate	0.32	0.7
9/16/2003	SLD OR 200303061	MS-2	bis(2-Ethylhexyl)phthalate	0.13	0.4
1/6/2004	SLD OR 200400014	RBG-1	Di-n-butylphthalate	0.19	1.1
1/6/2004	SLD OR 200400014	RBG-1	Diethylphthalate	0.32	5.8
1/6/2004	SLD OR 200400014	RBG-1	bis(2-Ethylhexyl)phthalate	0.13	22.5
1/6/2004	SLD OR 200400012	RBG-2	Diethylphthalate	0.32	6.3
1/6/2004	SLD OR 200400012	RBG-2	bis(2-Ethylhexyl)phthalate	0.13	9.4
2/5/2004	SLD OR 200400150	RBG-8	Diethylphthalate	0.32	0.4
2/5/2004	SLD OR 200400150	RBG-8	bis(2-Ethylhexyl)phthalate	0.13	3.5

Table 3.5 Available Volatile Organic Compound Analyses

	October-01	September-03	December-03	January-February 04	July-04	March-05	June-05	August-September 05
BS-1						x	x	
BS-2						x	x	
BS-3								
BS-4						x	x	
BS-5							x	
BS-6						x	x	
BS-7						x	x	
RBS-1								
RBS-2						x		x
RBS-3						x		x
RBS-4								x
RBS-5								x
RBS-6								x
RBS-7						x		x
RBS-8						x		x
RBS-9						x	x	x
RBS-10								x
RBG-1					x	x		x
RBG-2					x	x		x
RBG-3					x	x		x
RBG-4					x	x		x
RBG-5					x	x		x
RBG-6					x	x		x
RBG-7					x	x	x	x
RBG-8					x	x	x	x
RBG-9					x	x	x	x
RBG-10					x	x	x	x
MS-1						x	x	x
MS-2							x	x
MS-3						x	x	x
MS-4								
MS-5							x	x
MS-6						x	x	x
MS-7						x	x	x
MS-8						x	x	x
MG-1					x	x	x	x
MG-2					x	x	x	x
MG-3					x	x	x	x
MG-4					x	x	x	x
MG-5					x	x	x	x
MG-6					x	x	x	x
MG-7					x	x	x	x
MG-8					x	x	x	

3.1.4 Surfactants

Surfactants (**surf**ace **act**ive **a**ge**nt**) are a class of compounds that serve as wetting agents. These compounds lower the surface tension of a liquid, allowing the liquid to spread more easily, and lower the interfacial tension between two liquids. They are widely used in a variety of household products (soaps, foams, waxes, cleansers) and industrial applications. Of particular interest is there use in agrichemical formulations to help in the disbursement of pesticides and herbicides.

Due to the lack of detection of pesticides, herbicides and semivolatile organic compounds, the analyses list was expanded to include surfactants starting in July 2004. Surfactants have been analyzed for all samples collected since March 2005. The analysis does not identify specific compounds, but addresses the concentration of the compounds as a class.

Table 3.7 presents a list of samples with detectable concentrations of surfactants. The only samples with detectable concentrations were from the Malpais Rd transect and only occurred in the June 2005 samples and at concentrations only slightly above the detection limit. Each of the locations is associated with an irrigation drain rather than a canal, and not all drains indicated detectable concentrations. The presence of these compounds indicates some minor impact by surfactants, but the source may be non-agricultural. Given the lack of detection of semivolatile or volatile organic compounds, a non-agricultural and non-industrial source is suspected. The source could be as simple as stormwater runoff from nearby roads or stormwater drains.

Table 3.6 Available Surfactant Analyses

	October-01	September-03	December-03	January-February 04	July-04	March-05	June-05	August-September 05
BS-1						x	x	
BS-2						x	x	
BS-3								
BS-4						x	x	
BS-5							x	
BS-6						x	x	
BS-7						x	x	
RBS-1								x
RBS-2						x		x
RBS-3						x		x
RBS-4								x
RBS-5								x
RBS-6								x
RBS-7						x		x
RBS-8						x		x
RBS-9							x	x
RBS-10								x
RBG-1					x	x		x
RBG-2					x	x		x
RBG-3					x	x		x
RBG-4					x	x		x
RBG-5					x	x		x
RBG-6					x	x		x
RBG-7					x	x	x	x
RBG-8					x	x	x	x
RBG-9					x	x	x	x
RBG-10					x	x	x	x
MS-1						x	x	x
MS-2							x	x
MS-3						x	x	x
MS-4								
MS-5							x	x
MS-6						x	x	x
MS-7						x	x	x
MS-8						x	x	x
MG-1					x	x	x	x
MG-2					x	x	x	x
MG-3					x	x	x	x
MG-4					x	x	x	x
MG-5					x	x	x	x
MG-6					x	x	x	x
MG-7					x	x	x	x
MG-8								

Table 3.7 Detected Surfactants

Sample Date	Sample ID	Detected Analyte	Detection Limit (ug/L)	Result (ug/L)
6/20/05	MS-1	Surfactants (MBAs Method 425.1)	<0.10	0.13
6/20/05	MG-1	Surfactants (MBAs Method 425.1)	<0.10	0.13
6/16/05	MG-6	Surfactants (MBAs Method 425.1)	<0.10	0.12
6/16/05	MS-7	Surfactants (MBAs Method 425.1)	<0.10	0.27
6/23/05	MG-7	Surfactants (MBAs Method 425.1)	<0.10	0.14
6/16/05	MS-8	Surfactants (MBAs Method 425.1)	<0.10	0.11

3.2 Fecal Coliform

Figure 3.1 provides a summary of the fecal coliform data by sample type (surface water, groundwater) and by transect location (Headwater, Rio Bravo, Malpais, and combined). The figure illustrates that the fecal coliform in groundwater wells is often not detected or is detected at concentrations less than a few colony forming units (cfu) / 100 ml along the transects. It also illustrates that the surface water samples at the headwaters and along both transects exhibit increased fecal coliform concentrations with respect to the adjacent groundwater. Figure 3.1 emphasizes that the surface water samples from the Malpais transect are significantly increased compared to the individual groupings and to the combined values for the entire data set.

The figure provides the maximum, minimum, mean, and geometric mean for each categorization. Fecal coliform counts ranged from Not Detected (assigned a value of 1 or 10 based on detection limit to allow for plotting and calculation) to as great as 7,200 cfu/100 ml. The greatest measured value was 7200 cfu / 100 ml at BS-3. The combined geometric mean and combined arithmetic mean were 18 and 228 cfu/100 ml respectively, with the geometric mean at the various transects ranging from 2 or 3 cfu / 100 ml for the groundwater monitoring wells, increasing to 54 to 64 cfu/ml for the headwaters and surface water locations along Rio Bravo, and up to 167 cfu/100 ml for the surface water locations along the Malpais transect. These results compare favorably with the results of the Middle Rio Grande Microbial Source Tracking Assessment Report discussed in Section 1.3 and summarized in Table 1.2. The results of that study indicated that under non-runoff conditions, the geometric mean values for the various sample locations in the South Valley under runoff and non-runoff conditions ranged from 9 to 490 cfu / 100ml.

At a more detailed level, the geometric means for the Las Padillas and Isleta Drains under runoff conditions were reported by the NMED as 36 and 200, respectively. These two locations correspond to Malpais surface sample locations 1, 2 and 3. The geometric mean for these three locations combined is 161 cfu /100 ml. Moving eastward along the transect, the reported values decrease for locations near the river. Of particular note, however, the surface sample locations for the Barr Drain exhibit some of the highest of the fecal coliform values for this study, ranging from 670 for site MS-7 and up to 4,800 cfu / 100 ml MS-8

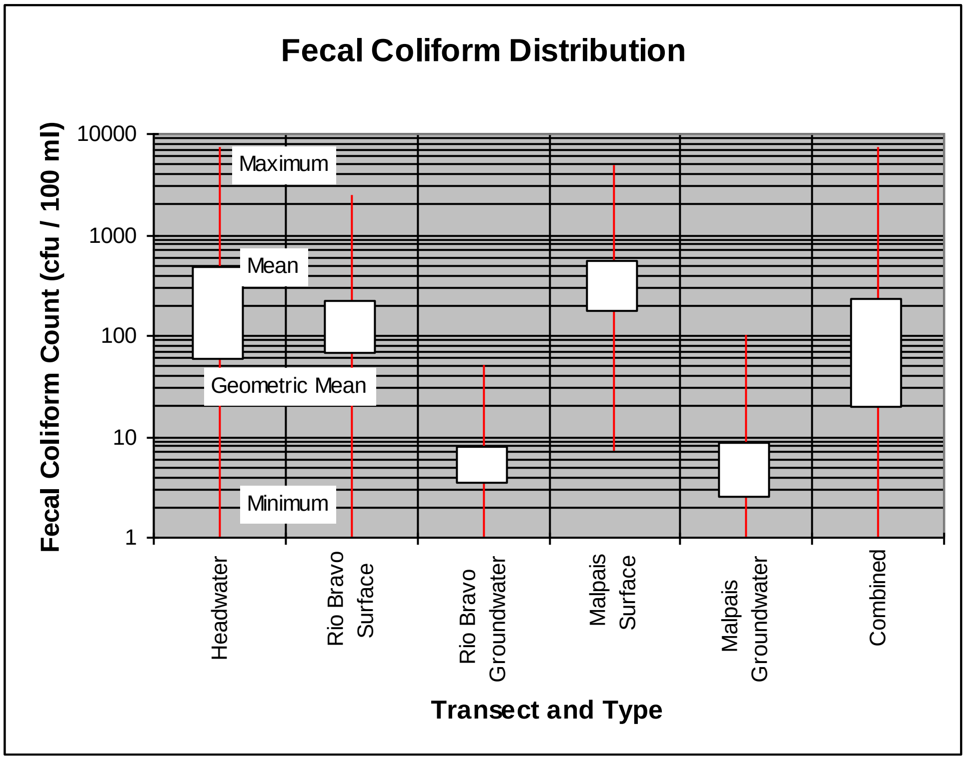


Figure 3.1 Summary of Fecal Coliform Analyses Results

A possible hypothesis is that the agricultural land use in the area east of the Las Padillas drain, particularly dairying and feedlot use, and attendant runoff and infiltration to the drains, may be causing the increase fecal coliform values. This area also exhibits low flow / stagnant conditions during much of the year.

3.3 Inorganics

Inorganics analyses for the program included nitrogen compounds and phosphorous (i.e., nutrients); trace metals analyses including arsenic, chromium, iron and manganese; and anion-cation analyses.

3.3.1 Nutrient Series

The nutrient-series analyses (nitrate+nitrite, ammonia (NH3) and Total Phosphorous) are available for the period of record. The quantification of the individual species nitrite NO_2 and nitrate NO_3 are available only since the July 2004 sampling event. Table 3.8 provides a summary of the available nutrient-series analyses. In the following figures and discussion, if a nitrate + nitrite (as N) value was not provided, the NO_3 value was used.

Table 3.8 Available Nutrient Series Analysis

	October-01	September-03	December-03	January-February 04	July-04	March-05	June-05	August-September 05
BS-1						x	x	
BS-2						x	x	
BS-3								
BS-4						x	x	
BS-5							x	
BS-6						x	x	
BS-7						x	x	
RBS-1	x							
RBS-2						x		x
RBS-3						x		x
RBS-4	x							x
RBS-5	x							x
RBS-6	x	x				x		x
RBS-7								
RBS-8	x					x		x
RBS-9							x	x
RBS-10	x							x
RBG-1				x	x	x		x
RBG-2				x	x	x		x
RBG-3				x		x		x
RBG-4				x	x	x		x
RBG-5				x	x	x		x
RBG-6				x	x	x		x
RBG-7				x	x	x	x	x
RBG-8				x	x	x	x	x
RBG-9				x		x	x	x
RBG-10					x		x	x
MS-1	x					x	x	x
MS-2		x					x	x
MS-3	x					x	x	x
MS-4								
MS-5							x	x
MS-6						x	x	x
MS-7		x				x	x	x
MS-8		x				x	x	x
MG-1		x			x	x	x	x
MG-2		x			x	x	x	x
MG-3		x			x	x	x	x
MG-4		x			x	x	x	x
MG-5		x			x	x	x	x
MG-6		x			x	x	x	x
MG-7		x			x	x	x	x
MG-8				x	x			

Figure 3.2 provides a plot of nitrate + nitrite (as N) in comparison to the Total Kjeldahl Nitrogen (TKN) concentrations and the respective histograms. In general nitrate+nitrite values (N) are less than 2 mg/L and TKN concentrations are less than 2 mg/L as shown in the histograms and suggests that nitrogen contamination, whether from wastewater systems or from fertilizer application is not of particular concern at the scale of the study area.

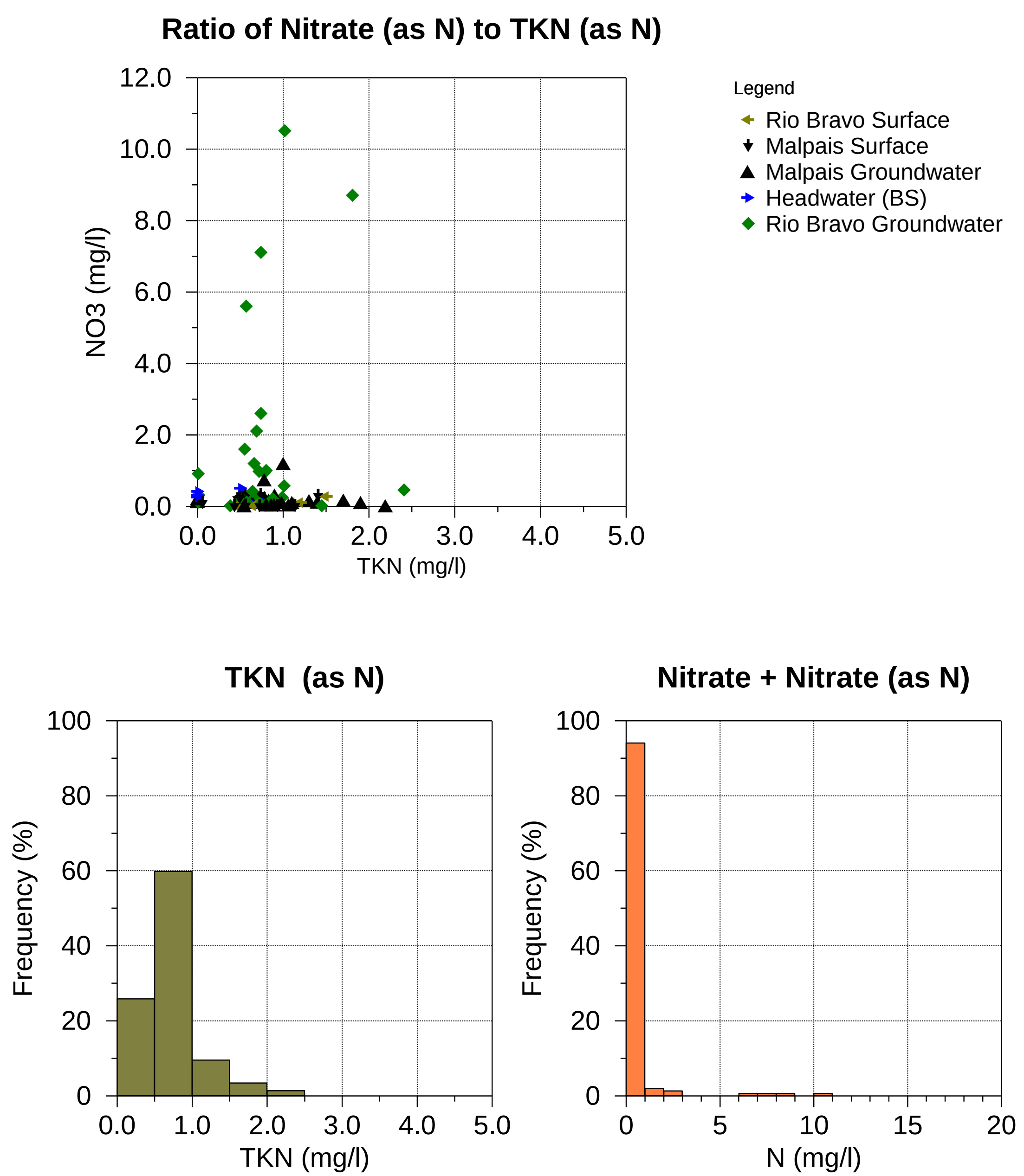
However, the figure also indicates that the nitrate+ nitrite values are of concern within the Rio Bravo groundwater transect, and TKN appears slightly elevated (greater than 2 mg/L) in the

Malpais groundwater transect. Detailed evaluation indicates that the samples with elevated nitrate+nitrate concentrations (i.e. greater than 5 mg/L) were collected from RBG-2, while the TKN concentrations greater than 1.5 mg/L were collected chiefly from MG-7 and MG-8 and, in one instance each from RBG-2 and RBG-10.

In the case of RBG-2, samples from companion well RBG-1 located across the drain and a few hundred feet north yielded samples with nitrate+nitrite concentrations <1 mg/L and associated surface water samples yielded nitrate concentrations less than 0.5 mg/L. Additionally, samples collected on 3/16/06 from a construction dewatering project along the Isleta drain near RBG-2 yielded samples with nitrogen concentrations of less than 0.2 mg/L. The construction dewatering wells screened a lower interval than that screened by RBG-2 and dewatered the monitoring well. These nearby sampling results indicate that regardless of the source of contamination (i.e. agricultural or septic), the extent (both laterally and vertically) was limited to near vicinity of RBG-2. Coupled with inorganic analyses discussed later, the elevated nitrate concentrations in RBG-2 are suggestive of septic contamination problems rather than a more widespread application of agricultural fertilizers.

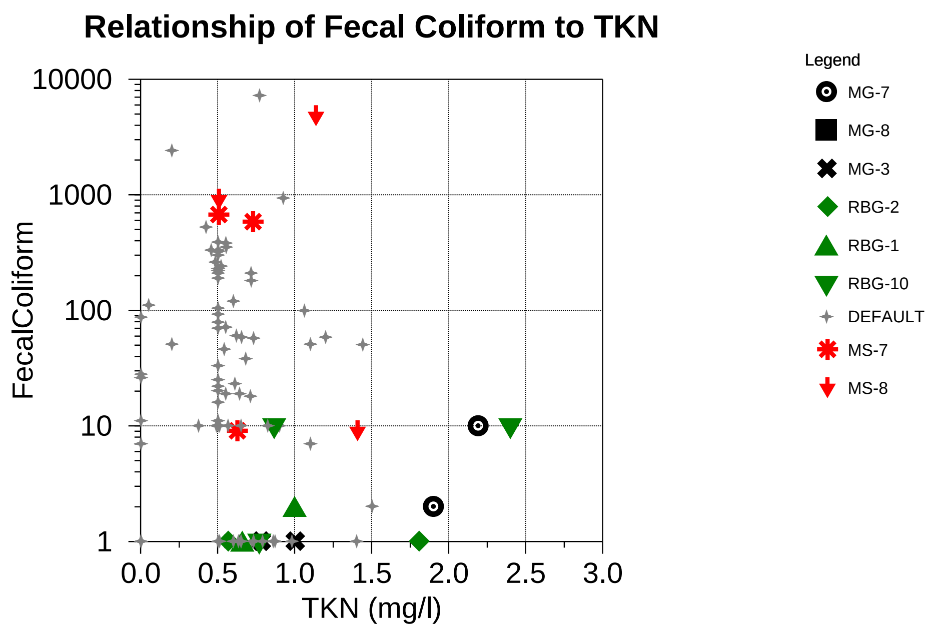
TKN concentrations are slightly elevated (respective to the remainder of the samples) in samples from wells MG-7, MG-8, and RBG-10. The sample locations for MG-7, RBG-10, and RBG-2 also exhibited elevated total dissolved solids concentrations. As shown in Figure 3.3, this is of interest because surface water samples from those locations (MS-7 and MS-8) exhibited elevated levels of fecal coliform, but not elevated concentrations of TKN. A review of land use suggests that the presence of feedlot and dairying operations upstream of the surface locations and associated wells may be a contributing factor to these relationships. However, the concentrations for TDS remain less than 1,000 mg/l, and fecal coliform concentrations in the shallow wells do not appear excessively elevated. Additionally, nitrate concentrations in the groundwater remain below the primary drinking water standards (10 mg/L). The cause for elevated TDS concentrations in samples from MG-3 is not known.

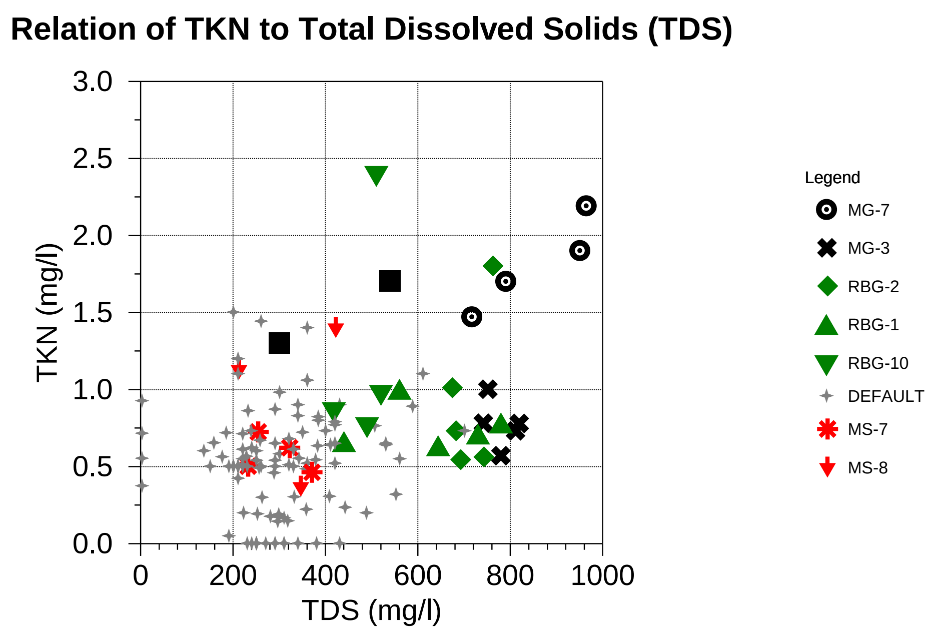
The implication is that the Barr Drain may be source of fecal coliform contamination to the Rio Grande, but that shallow groundwater is only marginally affected. Future monitoring of the drain and shallow groundwaters is advisable, but would be better tied to stormwater quality investigations rather than future groundwater investigations.



Bernalillo County Public Works / Water Resources	
Project: Agricultural Waste Impact Study	Date: 9/06
Description: **Nitrate and TKN Concentrations**	

Figure 3.2 Nitrate and TKN Concentrations





Bernalillo County Public Works / Water Resources		
Project:	Agricultural Waste Impact Study	Date: 9/06
Description:	**TKN Concentration Relationships**	

Figure 3.3 TKN Concentration Relationships

3.3.2 Metals

Sampling of surface water and wells prior to July 2004 included a protracted trace metal analyte list. Due to the generally low concentrations or non-detection, the analyte list was shortened to include only iron, manganese, arsenic, and chromium. Iron and manganese are indicator parameters for biological activity related to septic waste degradation and arsenic and chromium are common in agrichemical formulations. Table 3.9 provides a list of the available trace metals analysis. Since the July 2004 event, the indicator signifies only the existence of arsenic and chromium analysis and generally, iron and manganese as well. No analyses for lead have been performed.

Table 3.9 Available Trace Metals Analyses

	October-01	September-03	December-03	January-February 04	July-04	March-05	June-05	August-September 05
BS-1						x	x	
BS-2						x	x	
BS-3								
BS-4						x	x	
BS-5							x	
BS-6						x	x	
BS-7						x	x	
RBS-1								
RBS-2						x		x
RBS-3						x		x
RBS-4								x
RBS-5						x		x
RBS-6			x					x
RBS-7						x		x
RBS-8						x		x
RBS-9							x	x
RBS-10								x
RBG-1				x	x	x	x	x
RBG-2					x	x		x
RBG-3				x	x	x		x
RBG-4				x		x		x
RBG-5				x	x	x		x
RBG-6				x	x	x		x
RBG-7				x	x	x	x	x
RBG-8				x	x	x	x	x
RBG-9					x	x	x	x
RBG-10					x	x	x	x
MS-1						x	x	x
MS-2							x	x
MS-3						x	x	x
MS-4								
MS-5							x	x
MS-6						x	x	x
MS-7						x	x	x
MS-8						x	x	x
MG-1			x		x	x	x	x
MG-2			x		x	x	x	x
MG-3			x		x	x	x	x
MG-4			x		x	x	x	x
MG-5			x		x	x	x	x
MG-6			x		x	x	x	x
MG-7			x		x	x	x	x
MG-8			x		x			

Figure 3.4 provides a box and whiskers plot for trace metals concentrations. Analyses were run for groundwater samples from the Rio Bravo and Malpais transect on one sample from each of the wells. The analyses included each of the analytes shown in Figure 3.4. The absence of a plot for a given analyte signifies that there were no detections of that analytes in any of the samples (i.e. all value were reported as "<" the detection limit). The remaining values are all within normal ranges for surface and groundwater in the area. The seeming large range in concentrations for aluminum and zinc are likely due to difference in field sampling techniques – primarily whether the samples were filtered prior to acidification as discussed in Section 2. Unfiltered samples characteristically yield increased concentrations due to leaching of the metals from particulate and colloidal matter that may be present in the unfiltered samples.

3.3.2.1 Iron and Manganese

Iron and manganese analyses are available for most samples for the period of record. Of interest to this study are locations where concentrations of iron and manganese are greater than approximately 1.0 mg/L and particularly if there is an elevated nitrate concentration (i.e. greater than 1 mg/L). Such a condition is indicative of biological activity and denitrification processes. Figure 3.5 provides a plot for samples of interest.

Similar to the discussions for TKN, locations of interest include primarily RBG-2 and to a lesser degree RBG-1 and RBG-10. Location MG-7 demonstrates elevated concentrations of manganese, but without an associated elevated concentration of nitrate + nitrate. Location MG-5 also demonstrates elevated concentrations of iron and manganese, but without associated elevated nitrate + nitrite concentrations.

The presence of the elevated iron and manganese concentration again to the elevated nitrogen levels at RBG-2 being septic or wastewater related, particularly given that RBG-1 shows elevated concentrations of iron and manganese but not nitrates, suggesting that denitrification is occurring at the margins of the "hot-spot" surrounding RBG-2.

3.3.2.2 Arsenic and Chromium

Figure 3.6 provides a distribution plot for arsenic and chromium. Neither plot suggests that concentrations are abnormally distributed or that concentrations are indicative of study-scale contamination of groundwater or surface water. The narrow range in the interquantile for chromium is due to the large number of non-detects in the dataset. The non-detects are assumed equal to the detection limit for purposes of the calculation, and a narrow range results. Arsenic is naturally occurring in the aquifer of the study area. The two maximum points for chromium and arsenic were collected from wells RBG-4 and MG-6. These data points are anomalous given that other samples from these wells are reported with concentrations one to two orders of magnitude less than the maximums shown. There is no indication that the detected concentrations are elevated or indicate residual by-products from agrichemical use or degradation.

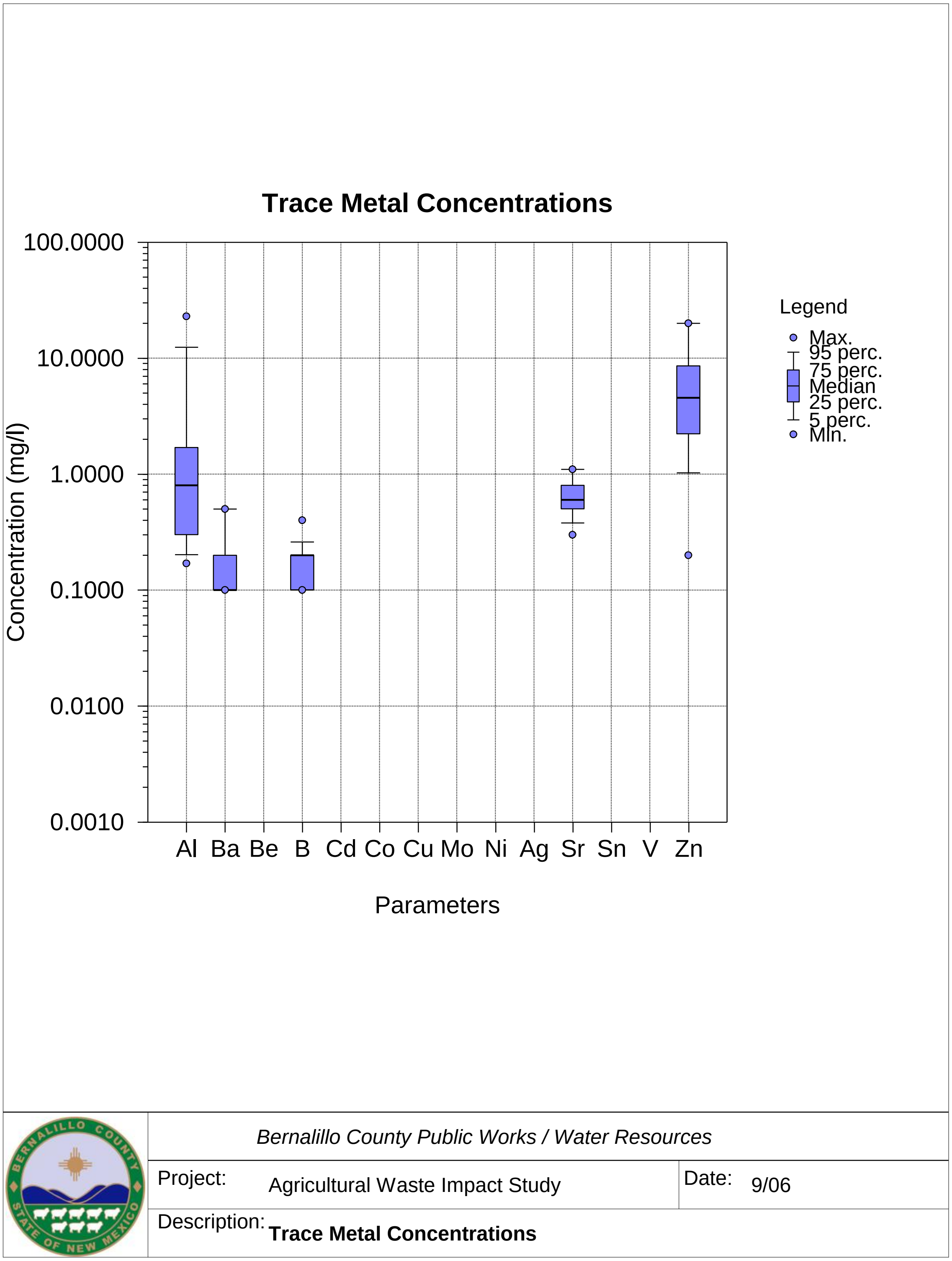
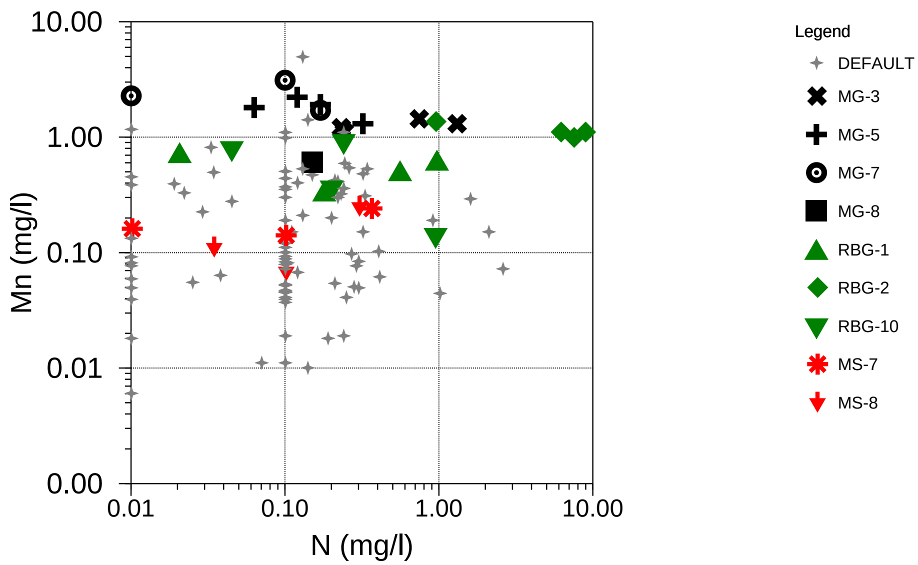
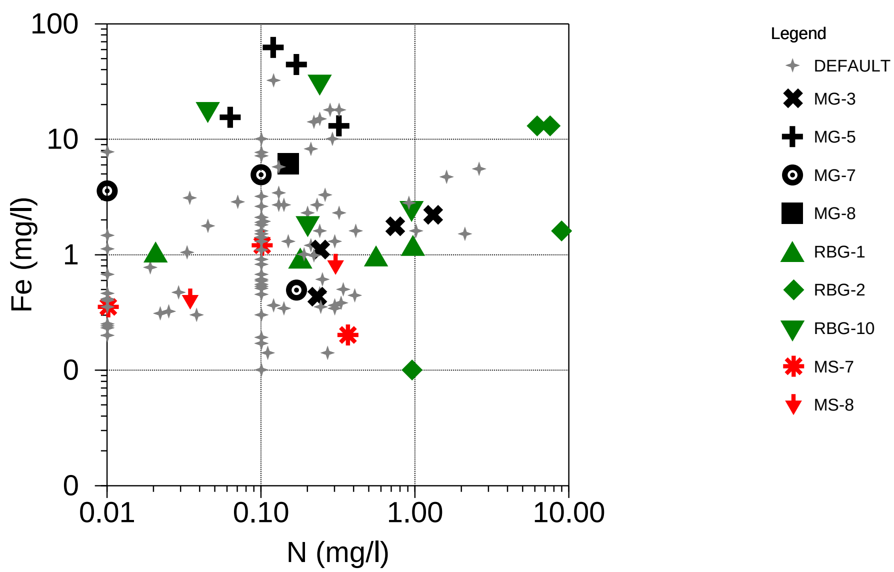


Figure 3.4 Trace Metal Concentrations

Relationship of Manganese and Nitrate + Nitrite

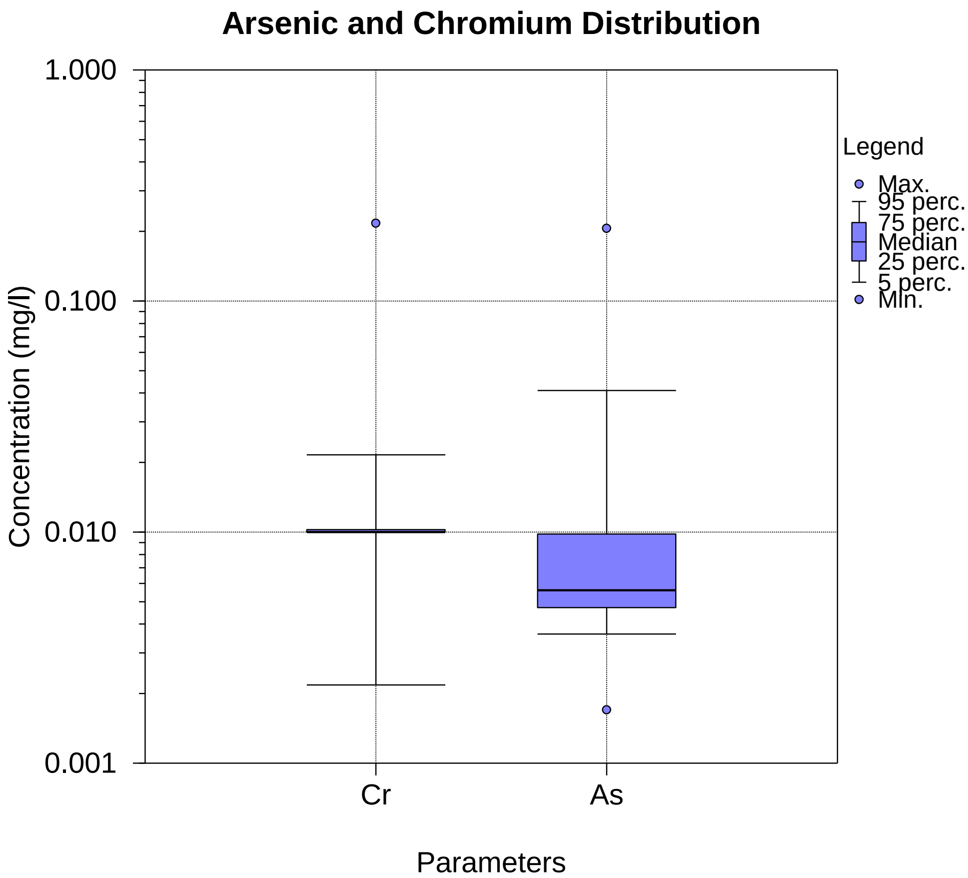


Relationship of Iron and Nitrate + Nitrite



Bernalillo County Public Works / Water Resources		
Project: Agricultural Waste Impact Study		Date: 9/06
Description: **Manganese and Iron Concentrations**		

Figure 3.5 Manganese and Iron Concentrations



Bernalillo County Public Works / Water Resources			
Project:	Agricultural Waste Impact Study	Date:	9/06
Description:	**Arsenic and Chromium Distribution**		

Figure 3.6 Arsenic and Chromium Distribution

3.3.3 Other Parameters

Analyses for the major cations and the major anions have been performed on all samples collected through September 2005. Additional descriptive parameters such as pH TDS, alkalinity and hardness generally are available for the period of record. Table 3.10 provides a list of the available anion-cation analysis for the period of record.

Table 3.10 Available Anion–Cation Analyses

	October-01	September-03	December-03	January-February 04	July-04	March-05	June-05	August-September 05
BS-1						x	x	
BS-2						x	x	
BS-3								
BS-4						x	x	
BS-5							x	
BS-6						x	x	
BS-7						x	x	
RBS-1	x							
RBS-2						x		x
RBS-3						x		x
RBS-4	x					x		x
RBS-5	x	x						x
RBS-6	x	x						x
RBS-7								x
RBS-8	x					x		x
RBS-9							x	x
RBS-10	x							x
RBG-1				x		x		x
RBG-2				x		x		x
RBG-3				x		x		x
RBG-4								
RBG-5				x		x		x
RBG-6				x		x		x
RBG-7				x		x	x	x
RBG-8				x		x	x	x
RBG-9						x	x	x
RBG-10						x	x	x
MS-1	x					x	x	x
MS-2							x	x
MS-3	x					x	x	x
MS-4								
MS-5							x	x
MS-6						x	x	x
MS-7		x				x	x	x
MS-8		x				x	x	x
MG-1		x				x	x	x
MG-2		x				x	x	x
MG-3		x				x	x	x
MG-4		x				x	x	x
MG-5		x				x	x	x
MG-6		x				x	x	x
MG-7				x		x	x	x
MG-8				x				

Figure 3.7 provides a plot of available anion-cation data using a conventional Piper diagram approach. From the upper left and moving counter-clockwise, the outlying values are single incidences of samples from locations BS-2, MG-1, MG-2, MG-3, RBG-4, and RBS-2. None of these anion-cation plots is abnormal for the South Valley based on area-side well sampling results by others. For comparison, Figure 3.8 provides anion-cation plots for samples collected throughout the South Valley by the USGS over a period of years. The only significant difference for the outlying values is the virtual absence of bicarbonate for samples taken from MG-1, MG-2, and MG-3.

Figure 3.9 provides correlation plots for sodium and chloride and for calcium and sulfate. Ideally, the sodium-chloride ratio should be 1:1 or higher. In this instance, a suggested ratio is approximately 1.67:1, with the increased sodium probably attributable to the predominance of silicate minerals stemming from the igneous nature of the alluvial fill material. Similarly, the ratio of calcium to sulfate should be 1:1 or lower. For the samples from this study, the ratio is approximately 0.77:1. Consequently, there is no indication of agricultural waste impact based on the inorganic analyses for anion and cation – the resulting ratios are attributable to the sediments comprising the source aquifer.

4.0 Water Level Data

No surface water elevation or flow rate measurements were made at the surface water sampling locations at the time of sampling, so determination of vertical gradients near the canals and drains is not feasible. Water level measurements in the shallow wells were made at the time of sampling. However, the records are incomplete and water level data for the sampling events prior to July 2004 are missing. The available data are presented in Table 4-1 and reflect a seasonal variation in water levels of approximately one-foot between irrigation and non-irrigation seasons.

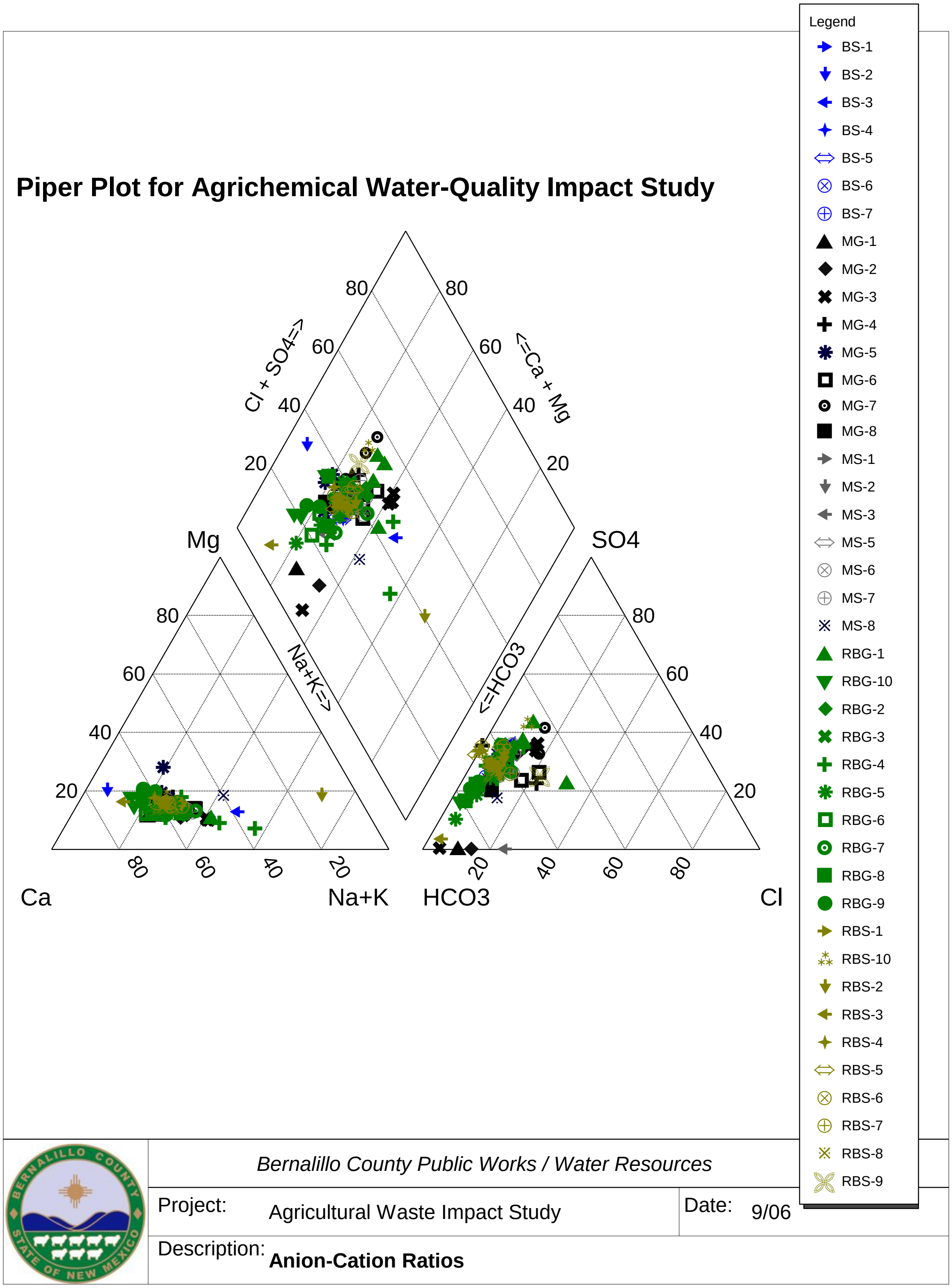
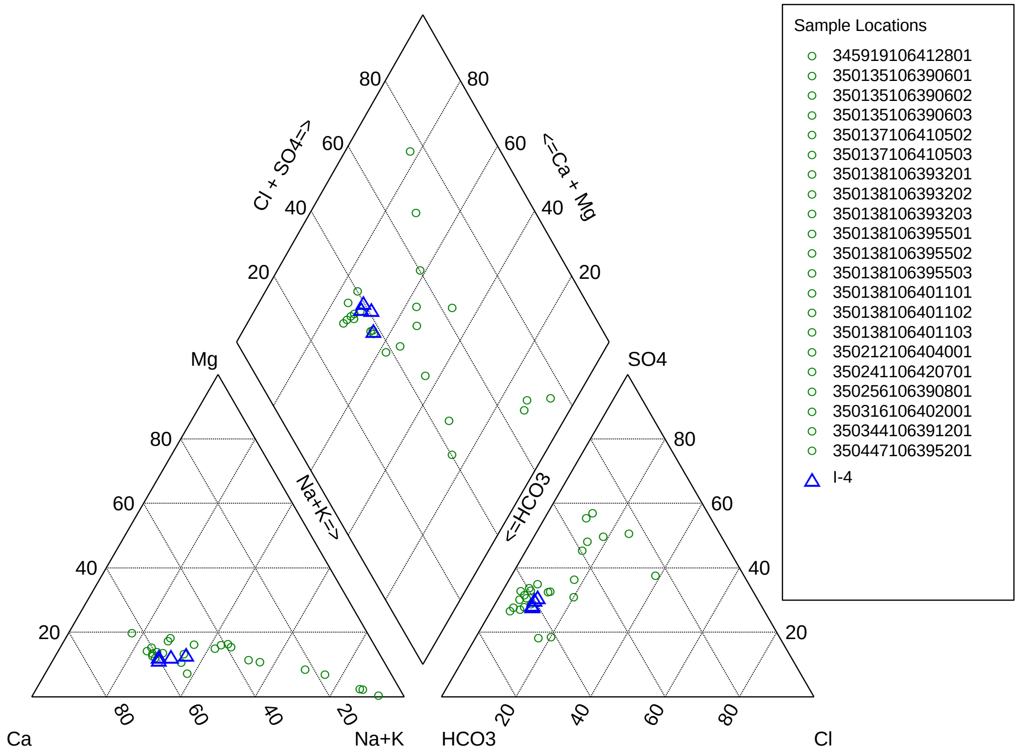


Figure 3.7 Piper Plot for Agrichemical Water-Quality Impact Study

Piper Plot for South Valley Shallow Wells



Bernalillo County Public Works / Water Resources		
Project: Water Report		Date: 9/06
Description: **Piper Plot for South Valley Shallow Wells**		

Figure 3.8 Piper Plot for South Valley Shallow Groundwater Wells

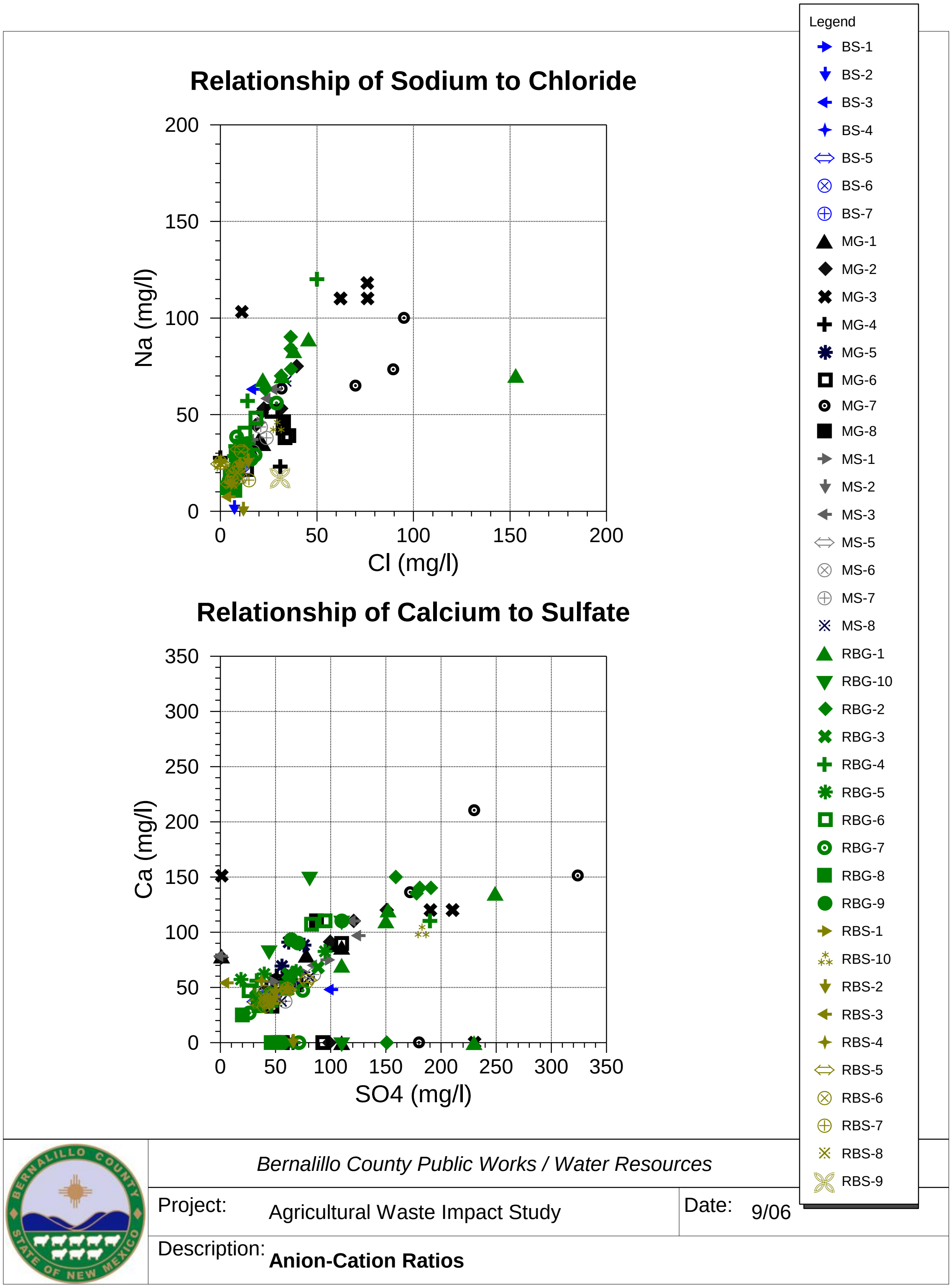


Figure 3.9 Key Anion-Cation Relationships

Table 3.11 Agrichemcial Water-Quality Impact Study Water Level Data

Ag Well Sampling Water Levels

	1st Quarter Sampling		2nd Quarter Sampling		3rd Quarter Sampling		1st Quarter Sampling	
Sample Site	Date	Depth to Water	Date	Depth to Water	Date	Depth to Water	Date	Depth to Water
BS-1	3/16/2005	n/a	6/7/2005	n/a	8/24/2005	n/a		
BS-2	3/16/2005	n/a	6/7/2005	n/a	8/24/2005	n/a		
BS-3	3/16/2005	no water	6/8/2005	n/a	8/24/2005	n/a		
BS-4	3/16/2005	n/a	6/7/2005	n/a	8/24/2005	n/a		
BS-5	3/16/2005	no water	6/7/2005	n/a	8/25/2005	n/a		
BS-6	3/14/2005	n/a	6/7/2005	n/a	8/25/2005	n/a		
BS-7	3/14/2005	n/a	6/7/2005	n/a	8/25/2005	n/a		
MG-1	3/7/2005	6.2	6/20/2005	5.2	9/8/2005	5.25	3/16/2006	6.00
MG-2	3/7/2005	6.6	6/20/2005	5.5	9/8/2005	5.60	3/16/2006	6.40
MG-3	3/7/2005	9.1	6/20/2005	8.0	9/8/2005	8.00	3/16/2006	8.95
MG-4	3/8/2005	8.3	6/15/2005	7.4	9/7/2005	8.00	3/16/2006	8.25
MG-5	3/8/2005	9.51	6/16/2005	8.1	9/7/2005	9.70	3/16/2006	9.00
MG-6	3/8/2005	5.8	6/16/2005	4.1	9/12/2005	4.45	3/16/2006	n/a
MG-7	3/8/2005	5.2	6/23/2005	3.1	9/12/2005	4.30	3/16/2006	5.20
MG-8	3/29/2005	6.1	6/16/2005	5.5	9/12/2005	5.70	3/16/2006	n/a
MS-1	3/7/2005	n/a	6/20/2005	n/a	9/8/2005	n/a		
MS-2	3/7/2005	no water	6/20/2005	n/a	9/8/2005	n/a		
MS-3	3/7/2005	n/a	6/20/2005	n/a	9/8/2005	n/a		
MS-4	3/7/2005	site not found		site not found		site not found		
MS-5	3/8/2005	no water	6/16/2005	n/a	9/7/2005	n/a		
MS-6	3/8/2005	n/a	6/16/2005	n/a	9/7/2005	n/a		
MS-7	3/9/2005	n/a	6/16/2005	n/a	9/12/2005	n/a		
MS-8	3/8/2005	n/a	6/16/2005	n/a	9/12/2005	n/a		

Table 3.11 Agrichemcial Water-Quality Impact Study Water Level Data Agricultural (continued)

Ag Well Sampling Water Levels (Continued)

	1st Quarter Sampling		2nd Quarter Sampling		3rd Quarter Sampling		1st Quarter Sampling	
Sample Site	Date	Depth to Water	Date	Depth to Water	Date	Depth to Water	Date	Depth to Water
RBG-1	3/29/2005	8.6	6/8/2005	7.8	8/29/2005	7.50	3/16/2006	n/a
RBG-2	3/29/2005	10.4	6/13/2005	9.5	8/29/2005	9.25	3/16/2006	14.30
RBG-3	3/10/2005	12'.0	6/13/2005	11.1	8/30/2005	11.30	3/16/2006	11.30
RBG-4	3/10/2005	11.1	6/14/2005	10.2	8/30/2005	10.30	3/16/2006	12.25
RBG-5	3/10/2005	10.5	6/14/2005	9.7	9/1/2005	9.90	3/16/2006	10.50
RBG-6	3/10/2005	10.8	6/14/2005	10.0	9/1/2005	10.20	3/16/2006	10.90
RBG-7	3/9/2005	5.1	6/15/2005	4.4	9/1/2005	4.90	3/16/2006	4.90
RBG-8	3/9/2005	5.0	6/15/2005	4.1	9/1/2005	5.75	3/16/2006	4.85
RBG-9	3/9/2005	18.55"	6/15/2005	13.1	9/6/2005	14.95	3/16/2006	19.10
RBG-10	3/10/2005	19.1	6/15/2005	13.5	9/6/2005	15.55	3/16/2006	0.00
RBS-1	3/29/2005	n/a	6/8/2005	n/a	8/25/2005	n/a		
RBS-2	3/29/2005	n/a	6/8/2005	n/a	8/29/2005	n/a		
RBS-3	3/16/2005	n/a	6/13/2005	n/a	8/29/2005	n/a		
RBS-4	3/16/2005	no water	6/13/2005	n/a	8/30/2005	n/a		
RBS-5	3/10/2005	no water	6/13/2005	n/a	8/30/2005	n/a		
RBS-6	3/10/2005	no water	6/14/2005	n/a	9/1/2005	n/a		
RBS-7	3/9/2005	n/a	6/14/2005	n/a	9/1/2005	n/a		
RBS-8	3/9/2005	n/a	6/14/2005	n/a	8/30/2005	n/a		
RBS-9	3/9/2005	no water	6/15/2005	n/a	9/7/2005	n/a		
RBS-10	3/10/2005	no water	6/15/2005	no water	9/7/2005	n/a		

5.0 Findings and Recommendations

This report documents results of surface water and groundwater monitoring conducted during 2001 to 2005 in the South Valley area of Bernalillo County, NM. The agricultural chemical (agrichemical) water quality impact study is based on samples collected from a monitoring network of a total of forty-five surface water and shallow groundwater sampling locations located in the South Valley. The samples collected for this study are representative only of the surface water and groundwater affected by surface-water interaction along the irrigation drainages and canals and may not be representative of groundwater conditions in outlying areas. Other areas of groundwater contamination are known to exist within the South Valley area. This study was not designed nor intended to address groundwater contamination issues within those known areas.

Findings

With the stated limitations, the findings of this report indicate that the irrigation water, drainage water, and immediately adjacent shallow groundwater in the South Valley do not typically contain detectable levels of herbicides or pesticides or other organic compounds or exhibit significantly elevated levels of inorganic contaminants. To date, the analytical results from surface water samples and samples from the monitoring wells have yielded no detections of any pesticides, herbicides, or other organic compounds indicative of agrichemicals. Any elevated levels of inorganic constituents, such as nitrates, are readily attributable to other sources such as septic tanks. Elevated measurements of fecal coliform found in other overlapping studies such as the acequias monitoring are attributable to multiple sources present within the study area as well as to livestock operations. There is some indication that upstream land use activities may be affecting surface water, and to a minor extent, shallow groundwater quality near the Barr Drain. The acequias sampling study confirms concerns with fecal coliform contamination near MG-7 (the Albuquerque Riverside Drain site / Site 4 of the acequias study).

Recommendations

Based on the findings, the following recommendations are proffered:

- Discontinue routine water quality monitoring of the surface water and monitoring wells.

- Focus any agrichemical studies on shallow groundwater beneath agricultural fields and collect samples from nearby domestic wells rather than adjacent to canals, drains, and ensure adequate data are collected regarding timing and rate of chemical application.

- Do not expand the program to the North Valley without an initial reconnaissance of surface water to determine if such a program is warranted due to the presence of contaminants.

With respect to status and disposition of the existing wells and surface locations:

- Extend the MRGCD license and retain a portion the wells for water level monitoring transects in conjunction with on-going USGS studies, particularly along Rio Bravo Blvd..

- Determine whether monitoring of the Barr Drain surface and shallow groundwater monitoring wells are applicable locations for monitoring of stormwater quality runoff. If so, modify the program to address stormwater quality parameters and flow rate monitoring as allowed by the MRGCD license agreements for those locations.

- For retained locations, establish elevations to within 0.01 feet at wellheads and monitor elevation changes in canals and drains and related responses in the adjacent wells. Install pressure transducers and transducers in the wells, and if feasible establish stage recorders in the adjacent canals and drains.

- Identify County projects that may benefit from retention of wells in other locations such as future locations of detention or storm surge ponds, establish elevations at wells heads, and continue to monitor water levels at those locations.

- For the remainder of the wells, plug and abandon the locations per MRGCD license agreements.

APPENDIX A

Surface Water Monitoring Results for Acequias Located within Bernalillo County, 2005

Prepared by

Staff of Bernalillo County Office of Environmental Health

Surface Water Monitoring Results for Acequias Located within Bernalillo County, 2005

Introduction

The South Valley Partners for Environmental Justice (SVPEJ) worked in collaboration with the New Mexico Environment Department (NMED), Surface Water Quality Bureau to sample eight sites along acequias located in the North Valley and South Valley of Bernalillo County. The sampling was done in response to testimony provided by community residents on surface water quality standards during the Triennial Review held before the Water Quality Control Board in 2004. Residents testified that they had witnessed people swimming in the Rio Grande and acequias that run through Bernalillo County and requested that the Water Quality Control Board change the designated use of this reach of the Rio Grande from secondary to primary contact. The change in designation from secondary to primary contact, to account for the use of the Rio Grande by swimmer, was subsequently approved by the Water Quality Control Board the same year. The residents were also concerned about the quality of water, particularly the occurrence of pesticides in the acequias, and possible exposure of swimmers to these contaminants. In response to these concerns, and the finding that there had been no prior sampling of acequias in Bernalillo County, eight sampling sites were selected by community residents based on their familiarity with existing and prior land uses and potential contaminants.

NMED personnel sampled three of the eight sites (sites 2, 3, and 4), while the other five sites (sites 1, 5, 6, 7, and 8) were sampled by the South Valley Partners for Environmental Justice partners and promoters. NMED Surface Water Quality Bureau personnel trained personnel and promoters on the following: 1) sample collection, 2) quality assurance, and 3) quality control. The training was conducted based on EPA approved quality assurance/quality control protocols.

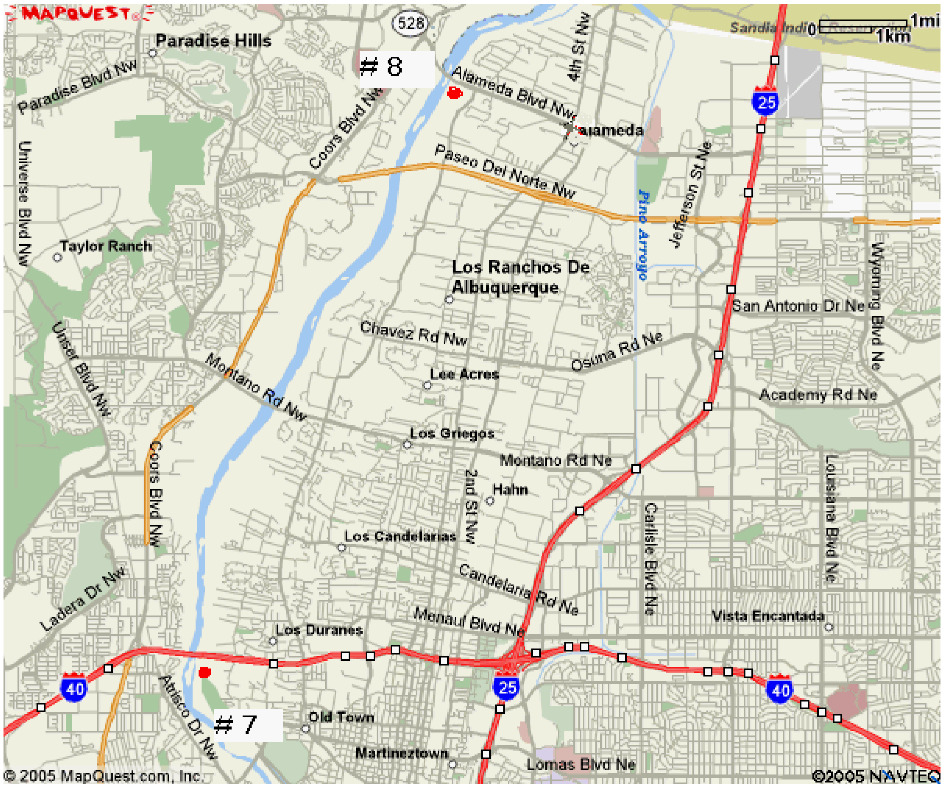
Samples were collected at the above sites, 1 through 8, on three separate occasions representing the three distinct seasons of spring, summer and fall. Therefore, a total of twenty-four sampling events took place during the project period; fifteen sampling events conducted by the SVPEJ and nine sampling events were conducted by NMED.

SVPEJ collected their spring samples from June 22-24, 2005, their summer samples from July 27-28, 2005, and their fall samples from October 18-19, 2005. NMED collected their spring samples from June 22-24, 2005, their summer samples on August 9, 2005, and their fall samples on September 9, 2005. All samples collected, whether by NMED or by SVPEJ, were analyzed for *E. Coli*, total and dissolved trace metals, nutrients, ions, and semivolatile organics. For the semi-volatile organics, NMED also collected soil samples for sites 2, 3, and 4. All samples, those collected by NMED and those collected by SVPEJ, were submitted to the New Mexico Department of Health's State Laboratory Division for analysis.

Sampling Locations

Please contact the Bernalillo County, Office of Environmental Health for the latitude and longitude coordinates of each of the sampling sites. Sites 1 through 6 were located in the South Valley. Site 7 was just south of Interstate 40 near the river and site 8 was at Alameda Blvd. in the North Valley. The following table describes each of the eight sites along with their locations.

Site # and Responsible Party	**Site Description**	**Driving Directions**
Site 1 SVPEJ	Ranchos de Atrisco Acequia (ditch) at Arenal Rd., SW	On Arenal Rd. between Gallegos Rd. and Lopez Rd.
Site 2 NMED	San José Drain, South of General Electric facility, just South of where railroad tracks and acequia cross	From Woodward Blvd., between 2nd and Broadway, follow the ditch S on the E side of GE until the San Jose lateral crosses the drain.
Site 3 NMED	Convergence of Los Padillas Drain and Isleta Drain at I-25 , South of Malpais Rd.	Coors Blvd. S almost until I-25. Left on Malpais Rd. going E follow Los Padillas Drain S of Malpais until it joins Isleta Drain
Site 4 NMED	Convergence of Alb. Riverside Drain and Barr-Interior Drain; just N of I-25	Take 2nd St. south of Rio Bravo stay on west side of railroad tracks until north side of I-25, turn west to Riverside drain at junction of Barr to Drain.
Site 5 SVPEJ	Convergence of Isleta Indian Ditch and Indian Lateral	On Isleta Blvd. North of I-25 ~1mile to Ilfield Rd. turn east to ditch turn south on west side of ditch drive 100 yds. to junction of two ditches.
Site 6 SVPEJ	Isleta Drain at Ross Ditch crossing	Off Rio Bravo immediately east side of the 'new' Walmart east of Coors turn south on small dirt road on east side of Drain. Drive past the 1st pipe gate until you reach the Ross ditch crossing, just S of Walmart.
Site 7 SVPEJ	Overlap Drain (smaller drain) at west end of Mountain Rd.	Take Mtn. Rd. west until it ends. Follow paved path toward river.
Site 8 SVPEJ	Overlap Drain under Alameda Blvd. E of Río Grande	Alameda Blvd. West almost to the river



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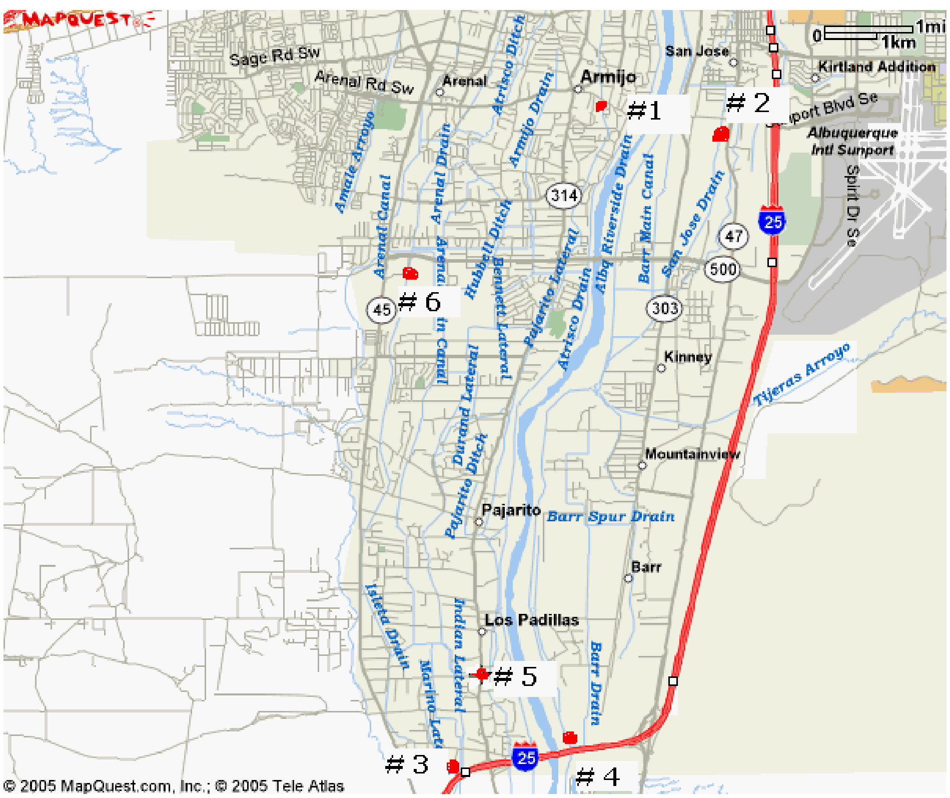

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NMED trains community promotoras on surface water sampling techniques. June 2005

Gloria Castillo collects water from the Isleta Indian Ditch site, June 2005

Water Quality Results

Note: As NMED sampled sites 2-4, their name appears on all tables and graphs for these sites.

E. Coli

Of the eight sites sampled, the San Jose Drain site (Site 2), the Los Padillas Drain site (Site 3), and the Albuquerque Riverside Drain site (Site 4) exceeded the New Mexico Administrative Code surface water quality standard for *E. Coli* of 410 cfu/100mls. All three sites exceeded the *E. Coli* standard in the fall, while the San Jose Drain site also exceeded the *E. Coli* standard in the spring.

For more detailed information, please contact Bernalillo County Office of Environmental Health and request: Table 1 and Graph 1 for *E. Coli* by site ID.

Ions

Ions include the following constituents: ion balance, total suspended solids, total dissolved solids, pH, sulfate, chloride, bicarbonate, carbonate, alkalinity, magnesium, calcium, hardness, sodium, and potassium. Of these, only total dissolved solids, sulfate, chloride, and pH have assigned surface water quality standards. None of the samples collected exceeded these assigned standards.

For more detailed information, please contact Bernalillo County Office of Environmental Health and request: Table 2 and Graph 2 for *Ions* by site ID.

Metals

Based on the surface water quality standards for dissolved aluminum, antimony, arsenic, boron, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, thallium, vanadium, and zinc, the San Jose site (Site 2) was found to exceed the standard of 0.00077 ppm for dissolved mercury in the fall. The following contaminants, barium, beryllium, manganese, silver, and uranium do not currently have surface water quality standards for them. There were no significant seasonal variations in contaminant concentrations.

For more detailed information, please contact Bernalillo County Office of Environmental Health and request: Table 3 and Graph 3 for *Metals* by site ID.

Nutrients

Of the nutrients that we tested for, total phosphorous, TKN, ammonia, and nitrate+ nitrite, only nitrite + nitrate has a surface water quality standard (132 mg/L). The others do not have assigned surface water quality standards. The samples collected that were analyzed for nitrite + nitrate did not exceed the surface water quality standards. Additionally, there did not appear to be any seasonal patterns of contaminant concentrations.

For more detailed information, please contact Bernalillo County Office of Environmental Health and request: Table 4 and Graph 4 for *Nutrients* by site ID.

Semivolatile Organics

There were no exceedances of any of the semivolatile organics tested based on the surface water quality standards. However, of the 97 constituents tested, 50 do not currently have surface water quality standards set for them.

For more detailed information, please contact Bernalillo County Office of Environmental Health and request: Table 5 and Graph 5 for *Semivolatiles* by site ID.

Soil Quality Results

Soil samples were also collected at Sites 2, 3 and 4 and tested for semi-volatile organics. None of the soil samples collected exceeded the health based screening levels established by the NMED Hazardous Waste Bureau and the Ground Water Quality Bureau Voluntary Remediation Program, and Superfund Section. However, 13 soil samples collected from the San Jose Drain site (Site 2) did exhibit detectable concentrations of semi-volatile organics. These include detection of benzo(a)anthrecene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,I)perylene, benzo(a)pyrene, bis(2-ethylhexyl)phthalate, butylbenzyl phthalate, chrysene, flouranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene. Soil samples collected from San Jose Drain site did exceed the reference dose (RfD) levels set by the EPA Integrated Risk Information System for three of the semi-volatile organic compounds. These include Bis(2-Ethylhexyl)phthalate, Fluoranthene, and Pyrene.

If a sample were to exceed these health-based screening levels, NMED would begin remediation activity at the site after a thorough assessment. Exceeding the screening levels warrant that action is taken to clean up the site.